Audio Title: Two Techniques for Total Knee Replacement
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Transcript

Intro: Welcome to this OR Live webcast live from Christiana Care Health System in Newark, Delaware. OR Live, a surgical broadcasting company.

Leo: Welcome. Welcome to Christina Care Health System in Wilmington, Delaware. We are here at Christiana Care Center for Advanced Joint Replacement. Our audience will be able to watch two live total knee replacements in our program. Two of our surgeons, Dr. Steven Dellose and Dr. Alex Bodenstab will be showing you the knee replacements. Dr. Dellose will be performing **a rotating-hinge type knee replacement** and I will be explaining that in a minute. Dr. Bodenstab will be doing an **MRI-assisted type of knee replacement**.

The purpose is for our audience to watch a knee replacement surgery. The knee replacement systems that are in use are all good systems. These are two examples of systems that we use here at the Center for Advanced Joint Replacement.

Questions throughout our program are encouraged. There is an Ask the Doctor area on your webpage where email questions will come in and we will be happy to answer those questions. I can direct those questions to Dr. Dellose as well as Dr. Bodenstab throughout the program. There will also be questions that you can send in to nurses at the Center for Advanced Joint Replacement. Our Joint Replacement Center is not just for surgeons that you will see today but it's a tremendous staff of nursing staff, physical therapists, and an entire system to help patients improve their quality of lives through knee replacement surgery.

I have a model that demonstrates the knee replacement that Dr. Dellose will be using. Knee replacement surgery, many patients think that we are replacing the whole joint. We are actually resurfacing the joint. You can see how thin, this is the metal component of a knee replacement, we usually only remove in the range of a quarter of an inch of the joint surface and actually put a new surface on the joint.

The plastic part of the tibia side, the shin side of the knee replacement, and the Dr. Dellose's knee surgery actually rotates throughout the arc of motion to allow better articulation as the knee moves and our tibia rotate slightly.

The World Health Organization Patient Safety Guidelines are followed here at Christiana Care Center for Advanced Joint Replacement. Surgeons review the surgery prior to incision. Our anesthesiologist will review the procedure prior to induction of anesthesia. Our anesthesiologist has done that prior to anesthesia for the patient of Dr. Dellose. And Dr. Dellose has reviewed this with a surgical team. We will now go to the operating room where Dr. Dellose is waiting to begin his knee replacement.

DR DELLOSE PERFORMING A ROTATING HINGE TYPE SURGERY

Steven: Thank you very much, Leo. I'd like to again, welcome everyone to Christiana Care Health System, Wilmington's Campus. Today, we'll be performing live knee replacement surgery. It's a right knee replacement on a 76-year-old female. She has had a left knee replacement back in '07 and has done well from that.

I'd like to take a brief moment to introduce our staff. This is our scrub nurse, **Denise Root** [Phonetic], our DuPont rep, Patrick Brown, Kristine Hopkins, our circulating nurse, our two physician assistants, Sean Smith and Joseph Cassidy, and our anesthesia staff, **Jean Toppin and Ralph Gucher** [Phonetic].

Before we get started, I'd also like to review the films. They are behind us. This lady is starting out with a varus knee which means that it is a bowlegged deformity and there will be a decreased space on the inside portion of the knee. And one of the two principles of knee replacement surgery is to correct the alignment of the knee and also balance the knee. And we will get started now.

What we're doing now is we're using an [0:04:22] [Indiscernible]. This is the way to take some of the blood out of this leg prior to raising the tourniquet. And this knee replacement, we are doing under a tourniquet so that it's mostly bloodless. Our incisions that we use are landmarks. This is the tibial tubercle. This is our kneecap. We usually go about a finger breath above and about two finger breaths below.

Leo: Steve, we've had questions already coming in. **Patients are interested in minimally invasive techniques in knee surgery.**

Steven: Yes. We are going to be using some of those techniques here. I think both Alex and I have the same exposure. You'll be seeing the exposure that we use in this knee replacement. Alex is using the same one but you won't be able to see it. One of our key principles is – and this is the quadriceps tendon here and we no longer violate that. This is the vastus medialis muscle and we're going to split that instead. So right at the level of the patella, we'll go ahead and put a little cut in line with the fibers of that tissue there.

And that's the joint fluid coming out. What we're doing is making a cut. You could find where our tibial tubercle is, right next to the patella tendon. There is the edge of the patella tendon. And that's how we get into the knee joint now.

This is the patella fat pad which I removed a lot of it and that's for visualization purposes. And for the public out there, this is an electrocautery that actually coagulates the tissue as we remove it. And what we're doing right now is even though our incision is basically in the center, most of the knee replacement is done from the medial side and it's done like this in both this knee replacement and the next.

But one thing you'll notice here is that we have osteophytes. These are again, where our arthritis is. They formed excess bone in this region. We're going to remove the rest of the fat pad at this stage.

Leo: Steve, we have another question from a woman who is 92 years old who skis and plays tennis and wants to know if she is too old to have a knee replacement.

Steven: Well, it really depends on her health, Leo, more than anything else. My philosophy is that if she's an active individual then she is – and it's safe to have a knee replacement then I think it's reasonable that she go ahead and have that done.

Leo: I find the same thing. It's really – I tell people, it's based on their health and how well they are. There are patients who are quite young in age who cannot have a knee replacement due to medical problems or the inability to participate with the physical therapy and rehabilitation required after knee replacement.

Steven: And at the present time, this system, not all systems, but this system, I'm removing the ACL and PCL and that's the anterior cruciate ligament and posterior cruciate ligament. We want to remove these in their entirety here.

Leo: We have another question from a woman who is 44 years old and was told that that she may need a knee replacement, and was interested in knowing how long knee replacements usually last.

Steven: Yeah. One of a – that's really a good question, a very common question. Knee replacements really depend on the activity level of the patient. I usually tell all of the patients in my office that it's really how hard you work it out. Meaning that if you put miles on a car, it's just like that. So you can wear it out faster if you're more active than someone who is not active.

So as a basis though, we have good results at 10 to 15 years but it seems like knee replacements are lasting longer and longer. Actually, this knee replacement just came out with some 25-year results.

And what we're doing here, Leo, is making our tibial cut. This knee replacement is a hair different in terms of the cuts we make. We are going to make a flat cut on our tibia with 7 degree posterior slope. And what we're doing is lining this up so that – and off of our preoperative templates, we're going to take very little medially and a little bit of bone laterally to make this neutral cut, and this will correct the alignment of our knee. And this cutting guide helps me do that.

And again, we looked at our preoperative templates to see where we were going to make those cuts. And we'll check those cuts in a minute.

One of the principles again, is to balance the knee and that's very important at the present time. And we're going to make some adjustments early in this knee replacement. And this is the medial meniscus here. We'll take a portion of that out. And again, that's just this osteophyte

that's not supposed to be there. It's just part of the balancing of the knee. We have to take that out.

And what I'm going to do now is look at my alignment and I like my alignment. I'm also going to pull soft tissue tension and make sure that when we straighten her leg out, which was initially like this, that when we straighten it out, it should be roughly straight. We'll make some adjustments later.

Leo: Steve, we had a very common question, **"Can you show us where the arthritis is?"**

Steven: Oh yeah. And she has quite a bit of it, Leo. This area right here is down to the level of bone. It is totally denuded of cartilage. You can see here, this is what cartilage looks like. That's what basically is on the bone when it's healthy. That's not real healthy on this side. And here, it's totally bone. I can't do that. These are osteophytes which are basically not supposed to be there. That's the body's reaction to arthritis. What it does is it – you produce osteophytes to decrease the stress in the knee so it's directly proportion to the surface area. So if your body increases the surface area, well then hopefully, decreases the force.

We know her sizes from her previous size. So this is an anterior referencing guide. So we're going to drill our hole.

Leo: I have a question about your space suit, and I'll answer that one. The space suits are environmentally-controlled. They have a cool circulating air to keep the surgeons and staff comfortable. It also protects the patient from any bacteria from the staff that might lead to an infection. Space suits are used to decrease any chance of infection.

Steven: And what we're doing now Leo is establishing the flexion gap. So this static tensioner makes a perfect rectangular shape there. We'll make these anterior and posterior cuts to dial in on rotation on our knee. And it makes a nice cut right in line with the anterior bone.

Leo: So you're using jigs to reference the patient's anatomy in order to remove the worn out surfaces to repair it to receive the new surface of the knee replacement.

Steven: Yes. And again, we're not making a lot of cuts. We're basically resurfacing the areas of bone. As you alluded to before, we're not taking a lot of bones. Let's make sure everything is released in the back there. Lock in rod structure. And we'll go clean the rest of that out but this is to really check our alignment and we put it 9 degrees. And this is again, we want to check our alignment to make sure we're right down the center here and it will correct the alignment of her knee, and that our gap is equivalent to the 10mm spacer that we're going to use.

Now, what we'll end up doing is matching the extension gap to the flexion gap so we'll end up making a distal cut and we'll also be 10 mm and that will balance our knee and correct the alignment.

Leo: And you're doing this so that the hinge ligaments on the side of the knee will be under the same tension whether the knee is straight or bent so it is nice and stable.

Steven: Correct. And that's one of the principles of knee replacement as well as correcting the deformity.

Leo: I have a good question, **"Why are the ACL and PCL remove for knee replacement?"**

Steven: Yeah, that's a good question. Originally, we just remove the anterior cruciate ligament. And a lot of times, the anterior cruciate ligament is not intact in these arthritic knees. And again, let me just go right quickly and tell you what we did is we just matched our extension gap to our flexion gap so that each of them are 10 and overall alignment is corrected.

But the PCL, there are knee replacements still on the market today that do not take the PCL. It's just really a surgeon's preference at this juncture whether they do that or not. Both knee replacements whether it's a cruciate retaining or posterior stabilized knee, both do well.

Leo: I have several questions on, **"What kind of range of motion you can expect after a knee replacement?"**

Steven: Yup. It really depends on a couple of factors. Body habit for sure as well as preoperative range of motion is a big determinant as well. The knee replacements nowadays all basically will allow for somewhere between 135 and 155 but the average range of motion in knee replacements is somewhere between 114 to 120.

Leo: There are good studies that are showing the average patient needs about 95 to 105 degrees of flexion to be able to go up and down stairs and to get in and out of a chair well. Many of our patients with arthritis do not have that much motion and certainly, hope to gain that motion more after the knee replacement. [I think having 105 to 110 is more reasonable for "normal" for performance of those activities]

Steven: These are just a series of jigs that again, we're resurfacing the femur.

Leo: We have a number of questions also coming in regarding what kind of activities people can do after a knee replacement. And I think Dr. Dellose would agree, and we really try to avoid high impact twisting type activities. For instance, we want people to swim, bike, play doubles tennis. I probably would discourage jogging for exercise, contact sports, snow skiing, downhill skiing. But I tell my patients that they certainly can cross-country skiing.

Steve, any thoughts on **activity levels for your patients?**

Steven: You know any more, Leo. I let them do a lot more than we used to because I found that they're going to do it anyway. So I will even let them downhill ski but they have to understand

that there are certain risks with those activities, and the risks are higher. They could mess up a good result if somebody runs into them or they break the bone around it.

And this is the exposed tibia here. We'll make sure we have all the soft tissue out of here.

Leo: Also, a number of **questions coming in regarding minimizing trauma**. I think that's the whole concept behind the minimally invasive type procedures. The knee replacement obviously and hip replacement surgery for that matter, the less trauma the patient undergoes, obviously the less postop pain and the quicker that they will recover after their joint replacement.

Steven: Yup. I mean that would be a principle. I think everybody is moving towards the – I'll say, not less invasive because I think there is a very invasive, obviously, very invasive surgery. But more tissue – the more we can save the tissues, the better off we are in the long run.

Leo: Now, these are the trial components that Dr. Dellose is putting in.

Steven: Yes. These are trial components.

Leo: And these are of number of sizes. We have eight different sizes available.

Steven: And one thing that we're really looking for is we have a very straight leg here. And again, we're looking for this maximum range of motion. And she has about 140 on her other side. And our patella is tracking very nicely. The rotating portion as you can see it rotate, most patients don't rotate 15 degrees but on average, somewhere between 6 and 8 degrees.

Now, we'll prepare the patella to suit our clips.

Leo: Do you always replace the patella?

Steven: I always resurface the patella. And what I'm doing here is just getting the soft tissue out of the way for – because I'm going to – I do not use a guide to do this. I find the guide is very cumbersome. So I just want the soft tissues out of my way before I go ahead and do this. And so, I'll preliminary cut although that's pretty good. And we want a certain thickness left, that much is pretty good.

Leo: OK. Just to try to reproduce the patient's normal anatomy so you're trying to reproduce that thickness the patient had before you got started?

Steven: Yes. We do to a certain extent. I just don't want to make it bigger than it was. Even if it's a hair smaller, I'm OK. But bigger would be bad. They'll get lack of motion if we do that.

So again, this is a trial component. And we're again, in full extension so it should be easy for this patient to get full extension. We push here to make sure that it doesn't flex up and we watch the patella tracking and that's very nice. It's sitting right on the – right where it's supposed to without any additives. And again, she has full flexion as well.

So at this point, we take out all these trial components while we're mixing cement on the back table here.

Leo: Steve, could you just show that one more time, that blue tibia component, the actual rotating part of the tibia.

Steven: And this is actually a better view because we have the kneecap out of the way. But you can see that this can rotate. You can see if you look right here, see that's internally rotated. The poly stays with the femur.

Leo: The actual blue component there in the picture is actually was rotating.

Steven: Correct. And then that also theoretically may help patella tracking. I'm not sure if that's true but it may.

Leo: We have some questions about having to do with a revision of a knee replacement in the future. One question was, **"Do you have to remove the whole knee or can you remove parts of the knee if they wear out?"**

Steven: That depends on how they fail. If they fail because they become loose, well then, you'll have to replace the whole thing. If they fail because of something wears out like the polyethylene wears out or the kneecap wears out, well then, you can go in and hopefully just replace those components.

Leo: The video camera pan back to the mixing of the cement. **Do you always cement, Steve?**

Steven: I do, Leo. And there are some really, really good studies in this knee replacement about cemented versus un-cemented. And I find no advantage to un-cemented. And actually, the results in this knee replacement don't do as well as the cemented. So I still cement everybody.

Leo: I also do cement everybody currently. However, we should tell our viewing audience that there are very, very good results with the un-cemented and cemented knees and very good long term studies. Yes?

Steven: And this knee replacement has been well-studied. And in this knee replacement, I'll make that clear, it has not done quite as well but still good but not quite as well.

I we like the bone somewhat dry when we cement this in then we'll get good exposure before we go ahead and place the real components in. And then we're making sure that there's nothing left residual. That's a piece of residual bone there that we've taken out. And this is the cement that we've been mixing. I don't like to over cement but we push it in to the bones. You see how much shinier the prosthesis, the real prosthesis is. Then we'll take this extra cement out.

Again, we have very good visualization. This is one of the areas where minimally invasive may not be as good because you may not be able to see any residual cement or residual bone. So …

Leo: So you cement there in the middle support for the tibial polyethylene tray, which I see you put in place and that is the actual rotating portion of the knee replacement.

Steven: Correct. And I'll show you that in one sec. As you can see, this would easily rotate in that. You can see that it easily glides on top of that. It articulates with two poly surfaces which is very nice.

Leo: People ask in my office commonly about the cement being a glue. And it's actually not a glue. It's a filler. It actually grabs the bone by going into this spongy portion of the bone and through contours on the backside of the prosthesis.

Steven: Yes, especially in the knee, space-depleted grout. And in a hip replacement, it acts totally differently but in knee replacement, just as you said.

Again, minimally invasive, you may have trouble getting any retained cement out of there. You can see that this is a properly-sized implant. Now, we sort of knew from a previous size but there's no overhang whatsoever of this implant over the bone and that's where the "female knee" comes into to play here.

Leo: We actually have some questions about the knees made for women only, and that is a knee replacement type system that I tend to use as well. And that overhang that Dr. Dellose mentioned, if you go on the inner and outer aspect of the femur is one of the reasons that some surgeons like that gender-specific knee. It tends to be a little narrower from side to side than the standards sizes. But there is no proof that that makes any difference in the long run in patient's quality of the knee replacement or the life of the knee replacement.

Steven: Most of the knee replacements, a lot of the redesigns came out in 1996 and later. And a lot of those knee replacements have female design changes already incorporated at that time like this one. They went through some female design changes in 1996.

Leo: Some of the other manufacturers of knee design replacements have also taken into account the rotating polyethylene on the tibia side.

Steven: Yes. Especially in revision surgery, Leo, I think that the very important revision surgery obviously doesn't do as well as primary. So there are some advantages in waiting maybe. But there's definitely an increased usage of rotating flat form knees in revisions.

So this is what it looks like cemented. We're basically done. One of the things we'll mention to you here, I don't know if you guys can see this but this is a restitution of the joint line. It's perfectly equal with our meniscus that was there previously. It's a decent shot of it I guess. And that's another important thing that we strive to do.

Whether to place a drain at the completion of the surgery?

So at this point, Leo, we usually place a drain. I don't know if you drain all your knees. I drain all my knees at the present time.

Leo: I usually don't. But I think it's reasonable to do obviously.

Steven: I go back and forth thinking about that. I don't think it's necessary but – and we do not keep the drain in long. We take it out tomorrow morning. No matter what, it's draining.

Leo: I think about 50% of surgeons drain but 50% don't.

Steven: Yeah, exactly. So that's why it's sort of flip flop. Again, we'll wash out this very well and then we'll flip this knee back up and make sure there's no residual cement again because when we do this, we always pressurize. And so again, I'll check to make sure everything is out.

Leo: What were you washing the knee out with? What do you like to use?

Steven: I just use plain saline. Some people mix antibiotics in, which they can do. I just use plain saline.

Now, we are 26 minutes into it, Leo, in terms of tourniquet time. I always close my first suture in extension but then I close the rest of the knee in flexion. And I don't know if that – there were some studies that suggested that flexion closure helps. But again, I'm not sure if that's true or not.

See where we just split this muscle? And so hopefully, that is more gratifying for the patient.

Leo: What are your thoughts, Steve, regarding computer-assisted knee replacements? I have a question here about robotic use in orthopedics.

Steven: I mean I don't – I mean the studies are now proving and that has been out for a couple of years that they might have improved a little bit in terms of the cuts. I think it's a great training tool, a very, very nice training tool if there are residents. We do not have residents here. It is time-consuming, that's for sure. It's expensive. And I don't think looking at all my postop films and patients results that it would help me. So I don't have any interest in using computer-assisted surgery at the present time.

Leo: I also have some questions about blood clots after surgery including a question about fat emboli. I would mention that all patients are placed on an anticoagulant whether it's aspirin or injection of a heparin type blood thinner. Some surgeons still use Coumadin, a blood thinner taken orally. But the studies are inconclusive of what's the best agent and it's really based on the surgeon's experience and preference.

Steven: Yeah. And I would say that nowadays even we're becoming, you probably want to look at it a more aggressive or less aggressive. I place my patients on a low-molecular-weight heparin in the hospital but then I just discharge them on aspirin. And I think a lot of the studies on DVT rates were done a while ago when we did not mobilize the patients as quickly. We mobilize the patients usually on the same day of surgery here at Christiana Care so we have a very aggressive rehab program and I think that makes a big difference.

Leo: Steve, I have a really good question about how long you can leave the tourniquet up to do the procedure.

Steven: The study suggests that you can leave it up for about two hours. You don't really want to exceed two hours. And in a primary case, very seldom where we ever get close to that. But in revisions, sometimes you do that. And you can let the tourniquet down for about 5 minutes and then sort of reinstitute it.

Again, before we go over to the Bodenstab, we'll just again, go through that range of motion. And passive range of motion really tells a lot about how the patient is going to do. So we always want a very good passive range of motion. She's doing extremely well here. Of course, she's nice and thin. Again, full extension too, which is very important.

Leo: Thank Dr. Dellose. It looks great. Whenever you're finished Doc, come over and join me.

I think Dr. Dellose has shown us an outstanding job of the few rotating hinge knee replacements. There are a number of good questions. I encourage folks to keep sending in their questions and click on Ask the Doctor.

Please also feel free to ask questions about nurses at our Joint Center as well. I have a number of questions regarding what influences a doctor's selection of what type of knee replacement to use. A lot of that comes in the training of that physician, what they actually were trained. Again, all of the major knee replacement systems and hip replacement systems really approved by the FDA have been rigorously investigated with good, short, and immediate and long-term results.

Longevity of Knee Replacement Implants?

There are theoretical advantages of some knee replacement designs over others but the long-term studies really done throughout the world, we're looking at tens of thousands of patients show that patients do surprisingly well with pretty much all of the major joint systems out there. That may change with time as we learn.

Obviously, knee replacements that we did 20 years ago, 85, 90%, 95% in some studies are holding up even 20 years down the road. People have asked a number of questions about how long a knee replacement last. If the principles that Dr. Dellose reviewed and I'm sure Dr. Bodenstab will review are followed about putting a leg in good alignment, meticulous technique in putting the knee replacement in correctly. There is no reason why a knee replacement with today's technology that should not last at least as long as the knee replacements done 20 years ago.

And again, most studies show greater than 90% are still doing well 20 years. We're actually starting to get 30-year follow-ups. I tell many of my patients that people have been doing knee replacements in this country in big numbers for the past 30 years, since early 1980. They started being done early 1970s, late 1960s although in very small numbers with poor designs.

We're not covering other technologies such as unicompartmental, which essentially is half knee resurfacing. But the knee replacements that you're seeing are still the gold standard regarding longevity and quality of outcome in patients' knees.

As Dr. Dellose mentioned, these are done for quality of life. The other common question coming through is, **"When should I consider a knee replacement?"** A knee replacement should be considered when it has affected the patient's quality of life to a significant degree. And that will vary patient by patient and by patient's own needs and desires and how active they want to live. We all remember before knee replacements and hip replacements were available, patients simply ending up in cane, wheelchairs, and being unable to ambulate.

But today, we have a society that wants to stay healthy and active and it's very important that patients decide with their surgeon based on review of their condition and also a failed conservative treatment.

We're not covering today that all patients are treated without surgery initially. There's actually a very small percentage of the patients that we see that we've asked to replace their knees that actually come to surgical intervention.

Dr Bodenstab and the MRI Assisted Knee Replacement

In a minute, we will progress to Dr. Bodenstab and I'd like to show the model of the technique that Dr. Bodenstab and other surgeons here at our Center for Advanced Joint Replacement have used. The new types of knees that are coming out that are called patient-specific knees, an MRI, or in some cases, a CAT scan is done of the patient's knee. And that anatomy is transferred via software and over the internet to a company that manufactures a plastic template. This plastic template fits on that patient's knee only.

So what is custom-made is actually the template that fits on that patient's femur. This is pinned in place as you'll see through Dr. Bodenstab's surgery. There was a slot on the top where the soft can be used to remove the worn surfaces to prepare the surface for the knee replacement. The actual knee replacement itself that's put in place is not custom-made for the patient. But these templates are custom-made based on that patient's own unique anatomy.

There is a template for the femur. There is also a template that is prepared for the upper part of the tibia, a little bit different from the instrumentation that Dr. Dellose used which referenced the patient's anatomy whether it was from the inner aspect of the bone or in the case of the tibia, what's called extra modular or from the outer reference landmarks.

With that, we will proceed to Dr. Bodenstab in the operating room to show you this total knee.

Alex: Great. And welcome to Wilmington Hospital at Christiana Care. I'm Dr. Alex Bodenstab and we're going to show you a little different wrinkle on knee replacement surgery. First of all, I want to congratulate Dr. Dellose on a very fine surgery. I'm sure that patient will do very well. Hopefully, my patient will do as well too.

Just as an introduction, I'm not just one person doing the surgery. Of course, I have assembled a team of individuals to work with me. I'm going to introduce them if I can right now. To my immediate right is **Donna Liege** [0:40:47] [Phonetic]. She's my scrub nurse. To my left, are two physician's assistants, Todd Miller and Tom Lowes who will be assisting me today. Behind the anesthesia screen, **Dr. Jean Toppin and Jane King** [Phonetic], the anesthetists, they will be monitoring the patient while she is having surgery done. Over to my right is **Audrey Eider** [Phonetic], she is our circulator nurse. She will be running all over the room this afternoon probably. And to her right is my Mike **Pompeos** [Phonetic], the sales representative who has brought the implants here today. And that's the team.

So just a little bit about my patient, my patient is a little bit younger than Dr. Dellose's. She is 61. She is a fairly active, healthy woman. She has already had, the same way that Dr. Dellose's patient, she has already had her left knee replacement done. She has had rapid progression of symptoms in her right knee and the x-rays do show that bone on bone collapsed that is so often, that we expect to see in patients who have end stage arthritis.

Staging of Knee Replacements?

And I just wanted to point that out, that kind of dispels the myth that I hear so often from patients that when they come in they say, "If I only get my one knee done right now, I know it's going to hurt so much. I don't want to have the other knee done later." And I think both of our patients today show you that that's not the case. The patients do well with their knee replacements, can do very well, and often choose to come back and have the other knee done.

Incision Length?

Well, while Dr. Dellose was finishing his surgery, we were starting our surgery here. I do a very similar approach to Dellose's. I just wanted to point out one issue. Patients ask about small incision surgery. This is admittedly a fairly small leg and if I measure the length of the incision that it's not quite 5 inches in extension, that is with the leg out straight. But when you flex the knee up, it's going to become much longer. So I think when you hear somebody telling you that they've had an incision through, a so long incision, it really depends on the individual, how big the patient is, and also whether they knee is bent or extended.

Another issue about the small incision surgery, when I first started doing knee surgery back in actually late 1970s, we made a much longer knee incision. It would start roughly a hand breath above the kneecap and go to a hand breath below the kneecap with the push to do smaller incision surgery. I am making my incisions a lot smaller now but I'm not going to try to do this surgery through a 2 or 3-inch incision. It's just impossible. It's more important I think for the patient's benefit long-term to do a well-done knee replacement right off the bat and not worry how long or short the incision might be.

I've already done some of the exposure here. The tourniquet has been inflated. We've already done our time out to identify the patient and that we're doing the proper operation on the proper leg. I've made an incision through the skin and I've raised the skin flaps. There's a little bit of fatty tissue under the skin. Then I've gone ahead and if I can just take a forceps here, I've made an incision very similar to Dellose's, right along the edge of the kneecap, patella, and then made an incision along the patellar tendon which attaches the kneecap to the tibia.

And then with the knee bent slightly, I made a split up into one of the muscles, one of the quadriceps muscles. So these are the muscles in the front of the thigh. This particular muscle is the vastus medialis. And by doing that, that enables us to slide the kneecap to the side so that I can then get to the rest of the knee. I'm going to put some retractors in now. And we'll redirect the light here a little bit.

And what we have the opportunity here, and I heard the question before about where is the arthritis, you can see it quite clearly. I can see it here. There might be a little bit of a color problem. The articular cartilage, the cartilage – the stuff that wears out in arthritis, the articular cartilage is for the most part intact on the outside, the lateral side of her knee and to some extent up in here. But we start to see some cartilage wear here and complete cartilage wear along this aspect of the femur bone. And then there is an area on the tibia with full thickness cartilage loss so that we see this bone on bone apposition that creates many of the symptoms that patients get in knee arthritis.

Now after I exposed that, I've also swept some of the soft tissue here and this is where we're going to take a little bit of a diversion from where Dellose did. This is the cutting guide that Raisis showed, let me put it down here, that has been fabricated by a company that took data from an MRI scan that was done in the weeks leading up to surgery and they decided for me exactly what size of implant I should use for today's surgery and also exactly how to position the component on the end of bone.

So I'm just going to slide this cutting guide on top of the femur, hold it in place and then my assistant is going to pin this cutting guided to the end of the femur. Now, this will determine – in this situation, I'm making the femoral cut first. Dr. Dellose made his tibial cut first. There's really no difference in terms of results. It's just again, based on a surgeon's preference. Often, what their training led them to do.

I'm going to switch with Tom. I'm going to make the distal cuts. Disengage this afterward.

Leo: Alex, we're having a number of questions about length of recovery, hospital stay. **How long do your patients stay in the hospital? What's the recovery like?**

Alex: Well, it has been – let me get this cut started here, Leo, and then I'll answer that question. Length of stay has certainly changed over the past several decades. I can remember again, admitting patients to the hospital and they'd be in the hospital for two to three weeks. Nowadays, the average length of stay here at the Christiana Care System is about three days although I think we're trying to improve on that too by getting patients mobilized more quickly, getting off out of

bed, getting them moving, and probably pushing them in physical therapy a little bit more. So we're hopefully going to be able to get the hospital stay down to perhaps as little as two nights in the hospital.

As far as the recovery afterwards, I think that depends on a number of factors that are both in my control and out of my control. I think if I do a better operation, a patient is likely to recover faster. I mean better in terms of assuring proper fit of the implants. But I think there are other factors in terms of how well patients are able to tolerate their physical therapy, how much pain they're able to put up with. I mean it is a painful operation as you might guess from watching what we're doing here today. But I think that with better pain control methods and better postoperative rehabilitation, we're more likely going to be able to get patients to recover faster. I would say that generally, it takes about 6 to 12 weeks for patients to recover.

Now just back to what I'm doing here, I'm going to make a preliminary cut just to be sure that I'm happy with the placement of this cutting guide. And then just to be sure that that cut is proper, I'm going to put a saw capture, this little device on here which then will direct the saw cut a little bit more accurately.

Leo: So the plastic template on the MRI that you use gave your initial cut for the end of the femur, gave you two pinholes and you used those pinholes to reference the jig you're using now.

Alex: That's correct. I didn't get a chance to point that out but maybe I want to pull this cutting guide off. And so, I've made the distal femoral cut. This cutting guide then is positioned where those two drill holes are. That's again, the position of the component has been determined on a preoperative MRI scan and then it actually makes this part of the operation pretty easy. I don't really have to guess about where I'm going to make these saw cuts.

Leo: Alex, **what do you do with your ACL and PCL?** We have a number of questions that are coming in regarding that.

Alex: I would say that the vast majority of knee replacements, I would think most of them require resection of the ACL. I mean you can't – you really can't get the exposure without removing the ACL. And then Steve showed you a technique where the PCL is also removed. The PCL sacrificing, the posterior cruciate ligament is removed. This particular knee system spares the PCL. So there's a PCL sparing.

In terms of overall results, I think there's very little difference between the two systems. And again, I think it's mostly surgeon's preference.

Leo: I think it's important for the audience to know that when the ACL is taken, the stability is built into the knee replacement and then certainly in the knee system that removes the ACL and PCL, also the stability is built into the knee replacement. We're getting questions about, "Do they need to be reconstructed after the knee replacement?" And that's not the case.

Alex: OK. There wasn't a question there, was there, Leo? Because I can't quite hear because of the saw.

Leo: No, sir.

Alex: OK. So now again, I'm going to remove this cutting guide and you can see again where those two holes were that determine where that cutting guide was going to fit. Now, we're just going to remove the extra pieces of bone here.

Leo: A lot of people have questions about being able to kneel on their knee replacement.

Alex: A great question. I encourage patients to try kneeling, I think that the problem is for most patients, it's either uncomfortable or because of the scar, it feels unusual or weird to kneel on the knee. I have had some patients who have been able to kneel very comfortably.

Squatting is difficult. Squatting requires even greater flexion than most patients obtained. I have had a few patients who were able to squat all the way down but that's very difficult.

I just want to point out since we're at that point right now, this little bit of tissue right here is the anterior cruciate ligament. I am cutting that away from the tibia, again, to allow better exposure of the tibia. The PCL lies behind that and I'm not going to sacrifice that. I'm just going to redirect the retractors here.

Leo: I have a number of **questions coming in, regarding the decision to have one knee or both done at the same time?** I think you touched on it earlier. But if you could give people your thoughts.

Alex: Well, there has been a disagreement among surgeons for years about the safety of doing one versus both knees at one time. I think there are some certain situations where I would advise patients not to do both knees at once. Certainly, if only on knee was symptomatic, I wouldn't tell them to get an asymptomatic knee replaced. But if – and let me just – I'll finish that thought. Let me just – as I'm working through here, let me just cut – this is the tibial cutting guide and it has slide in here too which is going to dictate where I make the tibial cut. This fits right on top of the tibia and I'm going to make sure that that's firmly seated. And then my assistant will again pin it in place.

But getting back to the …

Leo: Doing bilateral knees.

Alex: … single versus bilateral knees, I think if patients have – if they are markedly obese, and my cutoff has usually been about 300 pounds. If patients are over 300 pounds, I think it's very difficult to get them mobilized and get them moving or I think if patients have a very strong cardiac history. They've had maybe several stints placed or open heart surgery, I might be a little more cautious about doing a single stage bilateral knee replacement in a patient like that.

I think there is a good indication for doing both knees at once and that's when there is severe deformity. I find that if patients have marked flexion contracture that is where they can't fully straighten their knee. And you've seen these patients walking around with their knees all bent. If you straighten one knee out and then come back three months or six months later and do the other knee, they often redevelop that flexion contracture. So I think if they have marked deformity, I'm more inclined to do both at once.

Let me finish my saw cuts here. We're cooling – there's a lot of heat generated when the saw cuts to the bone particularly in this relatively young patient who has harder bones. Her bone is certainly not osteoporotic. And I want to cool down the saw blade a little and then making a cut.

Leo: There was a question about can patients with osteoporosis have a knee replacement?

Alex: Oh absolutely. This patient probably doesn't have much in a way of osteoporosis. Her bones seem fairly solid, not very porotic at all. The porosis really doesn't have anything to do with a knee replacement as much. It's just the fixation. If they have very soft bones, I'm much more inclined to cement the implants, which is what we saw Dr. Dellose doing. For this patient, since she does have pretty good solid bone, I'm more inclined to probably do an un-cemented implant.

Now, I finished the tibial cut. I'm just going to open the joint here a little bit in flexion and try to clean out some of the other tissue here. The tissue I grab right here is the medial meniscus. It's hard to see from back there but she had had a torn meniscus earlier in the disease process. She had had a knee arthroscopy done and then unfortunately sometime later, started developed more arthritis changes in the knee. So we see the remnant of the meniscus here.

Leo: Alex, I have a lot of questions coming in regarding how can you be sure that the knee and leg and aligned when you're doing knee replacement surgery?

Alex: I wonder who's asking that question. It gets into a whole different thought process about how we align the knee replacement. The traditional thinking in terms of alignment was that the patient's anatomy should be restored to a normal anatomy. The problem is, normal anatomy is all over the map that some patients even prior to the onset of arthritis, some people will have quite a bit of knock-knee deformity or some will have quite a bit of bowlegged deformity.

The whole concept with this system is that the knee is restored to the pre-morbid, the pre-arthritic alignment. And I think for me anyway and the patients who had surgery like this, I think that I've had some improved results with this system. I didn't exactly answer the question, did I?

Leo: I think that you answered it very well. There are different types of systems.

Alex: Sure.

Leo: And different theories. And again, time will tell which is the best long-term results but obviously, patients are going good results with all the various systems at this point. **If you you have a patient with hip arthritis and knee arthritis, which do you recommend doing first?**

Alex: Of course it depends on which is bothering the most. But we'll assume for the moment for this question that both joints are bothering the patient equally. I would probably get the hip done first. And the reason that is because I think that the recovery time from hip surgery is going to be less and that the patient will be more inclined to come back and get their knee done after we get their hip working better.

Leo: I found that also to be the case. I find that patients who pretty much say that their hip and knee hurts the same, I will recommend the hip done first. Many times, some of the knee pain maybe referred down from the hip and sometimes they don't need to have the knee done for a while.

Alex: OK. Now, I've debrided the back of the knee, the posterior aspect of the knee. I'm testing the ligament tension. The collateral ligaments are left intact. So I'm using a 9mm spacer block here and I'm going to place the knee both in flexion and extension just like Dr. Dellose did. It's full extension is very stable so I think that we're going to get a nicely balanced knee here.

This is the under surface of the kneecap which has now been turned over a little bit. There is a little minimal damage on the patella. But I too like to resurface most of the kneecaps so I'm going to use a device here. While I'm holding the kneecap, my assistant is going to use a reamer to remove some of the cartilage and a little bit of the underlying bone.

Leo: I think that both Dr. Dellose and yourself have raised issues, what's important is not the specific knee system that you use, it's putting in that knee system correctly, balancing your ligaments around the knee, correcting the anatomy and restoring normal function and doing it in a fashion that minimizes patient's discomfort and accelerates the recovery.

Alex: I would agree with that. And I think that the way to assure that is actually to see a surgeon who has a broad experience in that particular knee system. All of us here at the Joint Center have done a number of knee operations and I think we all feel pretty comfortable with the systems that we're using.

We're into the final preparation now of the tibial surface. And this is a small knee. This is a size 2 out of 8. So just because of tactical considerations, I'm going to place this trial using what I call best fit. I want to get good coverage here. Actually, I'm going to move that a little bit.

Leo: So the plastic template for the tibia allowed you to make your upper tibia cut and pretty much you're using this jig for rotation of the tibia at this point?

Alex: Yes, in order to finish the preparation of the tibia. So I'm trying to get best coverage on top of the tibia here. And …

Leo: **We've had some questions come through about what causes knee replacements to fail.** And I think what you're talking about right now proper coverage of the part of the tibia is one of the key factors because it seems in most knee replacements that failure comes from the tibial side and very rarely on the femoral side.

Alex: I think there are a lot of reasons why knees fail. And certainly, all the factors that we've talked about may play some factor. The knee is very complex joint. So I can adjust the thickness of the polyethylene. So I decided that the 9 is going to fit better so I want to get that in there and I just want [01:02:09] [Indiscernible].

Leo: I have a couple of questions from people. And Steve Dellose is here with me. Steve, maybe you can answer this question. **Somebody has only 20 degrees of motion in their knee and wants to know if they can have knee replacement.**

Alex: You mean this is preoperatively? Steve, you want to handle that one?

Leo: Yeah, Steve is going to handle that question.

Steven: Oh, that's a difficult one, Alex. You sure you don't want that one?

Alex: I'll wait to see what you say.

Steven: Well, I mean preoperative range of motion really is a big determining factor in postoperative range of motion. I think the rehab will be more difficult postoperatively. Now, there are a lot of reasons why – a lot number of reasons why their knee may only be moving 20 degrees and we certainly have to look at that to make any preoperative determinations. But I mean he certainly is a candidate for knee replacement. They may not get a 140 degrees range of motion out of it but it's certainly safe to say that there would probably be a big improvement on what they have.

Alex: I think as long as the patient understands that they're not going to get normal motion. They're probably not going to get that 110, 120 degrees of flexion that we'd like to see most of our patients get.

Let's go ahead and I'm going to leave the tourniquet up.

Steven: Alex, one question I have. Does the MRI tell you what size of the polyethylene or spacer you're going to use?

Alex: Most of the time, the MRIs will use – utilize an 11mm articular surface but you can downsize or upsize depending on the individual's situation. For the most part, I use an 11. Today, I'll be using a 9mm articular surface.

Steven: So it predicts an 11 so you can go up or down.

Alex: Yes.

Leo: I have a number of questions on, **"How I could, as a patient, prevent ending up with a knee replacement?"**

Alex: OK.

Leo: I think there are a number of factors there. Certainly, a number of questions have come in regarding weight control, very important, range of motion of the knee, maintaining good motion, good strength of the person's knee are the factors that we see. Obviously, patients have been very active and traumatic, very active with contact sports, suffered ligament injuries obviously an increase risk.

Alex: I think the biggest thing would be pick your parents. I think that there's very likely to be some strong genetic factors in the development of arthritis that we still haven't worked out.

So again, I'm using an un-cemented knee replacement. It got full extension. Flexion just in gravity is probably 110, 115 degrees. I could push it further than that. I think with some therapy, she might get to 120 degrees. And because I prefer using un-cemented implants, I'm also using a metal back patella because that has a porous surface on it. I don't know if you can see that one right there, with pegs on it. Those pegs will fit in the holes that we predrilled on the surface of the patella. And initially, it's just going to be helped with friction so I squeezed that down there.

Steven: And then you're hoping to get bone ingrowth into that porous surface?

Alex: Actually, this is a little bit of a different. I think there was a lot of concern in the past about metal back patella and having premature polyethylene wear and then causing the underlying metal to get exposed. Well, the plastic surface is much thicker nowadays. But I think the big advantage on this system is that it got good patellar alignment. In other words, the patella is not tilted one way or another. And so, the patella tracking has to be normal. So we're loading the patella normally. And I think there's going to be a lot less issue with wear over time. I really had no problems so far in the last two and a half years that I've been doing this with the patella.

So we're pretty much done here. We're just going to rinse out the knee. I prefer to use some antibiotics in my solution.

Leo: If you cement, Alex, do you use antibiotics in your cement for prevention of Infection?

Alex: Not, regularly, no. I mean there are some theoretical disadvantages about adding antibiotics to the cement in that it causes the cement to be a little weaker as a result of the antibiotics. It's being looked at.

Steven: How about you, Leo?

Leo: I actually like to use antibiotics in the cement. The studies that showed that cement loosening were actually on perfect cylinders of cement on a biomechanical tester called an Instron Machine and it decreases the amount of strength 10%. But in clinical practice, I don't think we make perfect cylinders of cement. Also, I'm very impressed by a study when I was a resident of knee replacements that were done on experimental animals and actually had bacteria injected into that knee. And one of the fewer groups that did not get infection were the ones that had antibiotic-used cement.

But a controversy nationally in orthopedics is, "Are we creating super bugs by getting resistant organisms if we use antibiotics in our cement retainment?"

Alex: I would agree with that. So I think on a revision operation where the incidence of infection is a lot higher than with a first time or primary knee replacement, I would certainly agree with adding antibiotics again on a revision situation. Maybe if someone is immune-compromised, if they're rheumatoid arthritis patient or on the steroids, I might consider putting antibiotics in the cement.

Leo: I have a good question regarding MRI use to make the actual implants of a knee replacement. If we have the MRI technology, why not make custom implants for the patient's knee?

Alex: Well, I think that the field is a little bit – people are already starting to think about that. There are custom implants that are being marketed now where they use MRI scans to design the implant. These tend to be mostly for, as far as I understand, mostly for partial replacements although I think they can do total knee replacements.

I have a little bit of concern with possibly the quality control issues on making the implants. So I don't know anything about that. So I mean [1:08:54] [Indiscernible] although clearly, if you have a custom-made implant, it might improve the results even more.

We're just closing up here. I'm putting a few of the stitches in. I'm doing a very similar closure to what Dr. Dellose already demonstrated. I think we can finish up here and we'll return to the moderator and I'll try to join Dr. Dellose and Dr. Raisis in just a couple of minutes.

Leo: Thank you, Alex. Well done. Steve, any thoughts? I'd like your opinion also. **A couple more questions are coming regarding doing one knee or doing both knees at the same time.**

Steven: At the present time, I do not do bilateral knee replacements. I do think looking at all studies, you have to be very careful at looking at studies. There was a meta-analysis about a year ago comparing a whole bunch of studies and then they collectively look at that data so that they had a large power in the study. And that showed a large increase in the number of complications seen in bilateral knee replacements.

Now, I do agree with Alex. There are those select few that may benefit from bilateral knee replacements if they have large deformities. But other than that, I do not take that increased risk.

Leo: There are also a few questions coming in regarding **what's the best way to minimize pain after the surgery? Is the discomfort from the bone work and the soft tissue work?** I think that's a good question. I think that's one of the reasons why the pendulum is kind of swinging back. We've been trying to – surgeons struggle through very small incisions. Still, the most important thing is having the knee replacement done correctly, put in correctly so that that knee replacement lasts 10, 20, 30 years.

Struggling through small incisions has not been found to decrease blood loss. It has not been found to change length of stay significantly. It also has not been found strangely enough to change patient's pain as much as you would expect. And that probably relates to that question we have regarding, "Is the discomfort from the bone work or the soft tissue work?" I think the bone work has a significant component to it.

But having said that, most of national research is designed towards again, getting patients through just comfortably as possible where we used to have people in the hospital for two weeks when we started doing knee replacements 25 years ago. We are like down the length of stays of three days and in some cases, two days, and made tremendous advances.

Steve, what do you use for postoperative pain relief for your patients?

Steven: Again, we use at the Joint Center here, I mean we all do the same thing to some respect. We inject the knee afterwards. Most of the anesthesia that we use, majority of it is a regional block or a spinal, sometimes we'll put long-acting medication in those knee replacement patients that may help them and also may decrease the risk of nausea and vomiting from pain medicines. Then we use a multi modal approach on the floor in terms of Tylenol and anti-inflammatories and pain medicines to try to decrease the amount of pain medicines that one has to take because there are certain complications or side effects from those pain medications.

What about Femoral Blocks?

Leo: We have a specific question from a physical therapist who works with joint patients and asked if we had any experience with femoral blocks which is just numbing the nerve in front of the thigh for postoperative pain relief. And we did do a clinical series of that. **Dr. Toppin** [Phonetic], our anesthesiologist at the Center for Advanced Joint Replacement looked at that, and we found that it worked in some patients but we had a number of patients with a weakness of their leg because in getting the numbing effect from the femoral block, we also got temporary paralysis of the quadriceps muscle, which of course resolved when block wore off. But it allowed patients to have too much instability of their knee and they could not get up walking. And we really would like people to get up walking, in many cases later that day of the surgery. Walking is obviously important to get range of motion to also facilitate their recovery and also decrease any chance of blood clots.

Steve, I don't know if you had any experience with femoral block patients.

Steven: Yeah, both in my fellowship and here we have tried femoral blocks. They're not without their complications. And one of our big goals here is mobilization of the patient. And that sometimes will sort of slow that down and that's a big part of decreasing the risk of complications postoperatively.

Leo: Alex, thanks. Great job. Steve, any question for Alex regarding the MRI knee?

Alex: It's fun. We should do this again sometimes.

Leo: Any questions for Steve regarding the LCS rotating-hinge knee?

Alex: No. Actually, it's a great design. I think it certainly – it's got a long track record. I think it has done well for Steve. And I've actually use these very similar designs in some of my revision surgeries.

Leo: I have one last question I'd like to cover. We only have about a minute left. **And a lot of questions have come in regarding blood loss, need for transfusion, giving or donating blood ahead of surgery, Dr. Bodenstab?**

Alex: Well again, I think that in certain select situations, I think if I'm going to be doing a difficult revision operation where I anticipate large amount of blood loss, and if the patient is an anemic preoperatively, I would have them auto donate. I would have them reserve a couple of units in the blood bank.

I think for most of the routine knee surgeries that I do however, the blood loos has been fairly nominal either during surgery, which you just witnessed, of course, or after surgery. The bleeding – there will be a little bleeding into the knee after surgery. That's usually not enough to require a transfusion.

I think so far the statistics of the Joint Center, there are about 20% of the patients who required transfusion. And I think for the other 80%, auto donating is probably not necessary.

Leo: I think we've discussed this at length with our hematologist and the hematologists have actually found that some of the patients donating blood ahead of time actually had a higher transfusion rate. And there's also a question regarding the usefulness of that blood when the blood goes off in the shelf refrigerator somewhere. When the patient gets it back, it's only about 40% effective. There's always a question about error of getting that unit back.

And also, the patients can be anemic just from having donated, as you mentioned that they're borderline before the surgery. I see the transfusion rate going down tremendously in the past few years, again, with a less invasive techniques and attention to detail and the surgical approach.

Steven: I agree with that. I think it's a very controversial subject. I do have a lot of my patients auto donate. And one of the big factors that I look at is the big picture. If I can avoid them getting someone else's blood then that's what I want to do. And studies have shown that if you auto donate that you decrease the risk of allogenic transfusion, and that's the bottom line. So that's really what I'm looking at.

Leo: Thank you Dr. Bodenstab and Dr. Dellose. And I'd like to thank the audience for tuning in at Christiana Care Health System's Center for Advanced Joint Replacement. Hopefully, you found this useful and informative. And certainly, please keep sending any questions in. We'll be happy to answer them after the program has ended.

Thank you very much for your attention. And if there's other final comment, I think we pretty much wrapped up. We appreciate your attention.

Outro: Thank you for watching this ORLive webcast presentation from Christiana Care Health System in Newark, Delaware. ORLive, a surgical broadcasting company.

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