Surgical Alternatives to Total Hip Replacement

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Hello, good afternoon, and welcome everybody. We are coming live from Saint Joseph's Hospital and Marshfield Clinic in Marshfield, Wisconsin. Thank you for joining us. I am Dr. Stig Jacobsen. I'm a pediatric orthopedic surgeon at Saint Joseph Hospital and Marshfield Clinic, and I'm your host here for today's program.

In the next one hour, we will be discussing some new surgical alternatives for total hip replacement. Joining us here today is first, Dr. James Conterato. Dr. Conterato is an anesthesiologist at Saint Joseph's Hospital and Marshfield Clinic and has a special interest in nerve catheter for surgery. Sitting next to Dr. Conterato is, Dr. David Simenstad. Dr. Simenstad is a Marshfield Clinic and Saint Joseph's Hospital orthopedic surgeon who has special training in total hip replacement or total joint replacement. And finally we have Dr. Charles Kenney, who is also a Saint Joseph Hospital and Marshfield Clinic radiologist with specialty training in joint and bone radiology. Welcome everybody.

During the program you will be able to send questions directly to the panel, and they'll be happy to answer it. Please push the icon, "Ask a question," and do that as soon as you'll like to, and we'll be able to answer the questions in the order they come in.

We will, on this program here, talk about the hip joint and we'll talk about surgical alternatives to hip replacement. I have a model of a hip here, and you can see the hip consists of a ball and socket joint. Here you have the ball, that's called the "femoral head." And here you have the socket or the acetabulum; that's the socket which fits in and is completely round.

You'll also here during today's presentation something called the "femoral neck," which is the part of the bone that connects the ball to the shaft. And both the ball, here, and the socket is covered by cartilage, and if that for whatever reason the cartilage is worn down then the patient will develop arthritis. And arthritis is basically a condition where you have no available cartilage and you're almost bone on bone, and that will basically give pain and stiffness in the patient's hip. And we do know that about 5 percent of all Americans who are 55 years of age has symptomatic hip arthritis.

We can see X-ray of a hip here, and to your left is a patient's right hip, and you have an arrow. And the arrow is basically pointing to the joint space, and you can see how narrow that is where Dr. Kenney is showing it here and how wide it is on the opposite side, which is representing osteoarthritis in the patient's hip.

The treatment of osteoarthritis is usually pretty conservative. It's usually anti-inflammatory drugs first. But very often, as time goes by and the arthritis gets more pronounced, then the medical treatment is not as effective anymore, so the solution that we have for arthritis in the hip is a total hip replacement. And we do know that there's over 200,000 total hip replacements taking place each year in the United States.

On this X-ray you can see X-ray of a hip joint to the left that has a lot of arthritis with secondary changes, and to the right you can see the same hip after surgery, where basically the ball and the

neck is replaced by a metal stem, and also the socket is replaced by either metal, plastic, or ceramic.

The two procedures we are going to discuss here today is basically procedures who are alternative to total hip replacement. It is hip impingement and resurfacing. And the hip impingement is a condition which there is an incongruency between the ball and the socket. You can see it's completely round, has a very nice fit into it. But if there's any incongruence, say a bump here between the neck and the head or either that the socket is protruding, then you will see as the hips move, there will be some incongruency, and that will cause pain. And untreated, that will usually lead to arthritis early on.

Dr. Simenstad will later tell us about the labrum, which is the seal that lays here that basically seals the hip joint off, just like you have a meniscus in the knee. And Dr. Simenstad, will you please tell me a little more in greater detail about this hip impingement and hip resurfacing.

Thank you, Dr. Jacobsen, I'd be grad to. Impingement is a diagnosis that's relatively recently been discovered so to speak. It's been a hidden diagnosis until this past decade. And it is actually a fairly common problem and probably existed previously but just was undiagnosed. And it's related to the abnormal shape of a hip ball or to the socket, as you showed us nicely. But it can also occur in a relatively normal ball and socket as well. But that happens usually when there's excessive movement or related to either laxity of the hip capsule or excessive range of motion in a patient, either due to their activity level or due to their laxity of this hip.

Most cases, though, are related to perinatal structural deformities, which occur in utero. And we think at this point in time that many of them are familial. Some can also, though, occur due to childhood developmental conditions such as slipped capital femoral epiphysis, which happens in the early years of childhood and can result in the hip growing abnormally or the ball growing abnormally related to chronic fracture or other conditions, which result in the head also becoming misshapened and thus resulting in the impinging problem as well.

As we start to understand more and more of this, we're understanding that there's a continuum of this problem. One that can be very mild and may not manifest itself until very later in life, and others with more severe incongruencies related to the head or the socket, which can result in significant problems either related to pain or arthritis at an earlier age. And so this is leading us to understand now that probably one of the single-most common causes of osteoarthritis is probably related to hip impingement, so it's an important diagnosis for all of us to understand.

Now the type of patients that I usually see with this type of problem frequently present under the age of 50, and their pain is localized right into their groin, and they particularly describe the pain as being worse with exertion. They frequently have loss of motion and particularly in hip flexion or bending of the hip, trying to bring their knee up to their chest so to speak. And this is either do to the fact that they are very painful doing this maneuver because of torn structures, which we'll talk about, or their structural abnormalities just will not allow it because of impingement of the ball against the socket.

Now this is a very subtle diagnosis, and that's probably one of the reasons it's the hidden diagnosis for so many years. But there are significant clues that we're starting to find out that help us understand it. But just to show you how difficult the diagnosis can be, that there's frequently on average about five years from time of symptoms to time of diagnosis. Many times patients will see more than one doctor before the diagnosis is made. And sometimes by the diagnosis is made, the progression of the disease process is beyond that that can be taken care with non-arthroplastic options.

So first of all, to understand this better, I think it's helpful to show what we consider the normal functional anatomy of the hip. You can see that the hip, as Dr. Kenney is going to point out for us, is essentially a round ball that fits in a socket that exactly matches the round sphere of the

head. And the angle of that socket is slightly inclined so that the front half of the socket is slightly in front of the back half of the socket, which allows the hip to flex fully. There's also several other very important structures, as Dr. Jacobsen described, which is the labrum in front and back of the socket, and these are like a gasket and conceal the synovial fluid and actually help preserve the hip socket long term.

When the hip is flexed the articular surface normally, which involves almost the entire part of the head, as Dr. Kenney will describe here, goes almost all the way down to the neck so that when the hip goes up into flexion, the entire part of the articular socket or surface goes into the socket. And the front of the neck does not really impinge because the front edge of the socket is slightly recessed in normal anatomy. Contract that to a cam-shaped head, which is what we're going to talk about today, which is basically a head which is just too big or oval shaped and so it won't actually rotate into a spherical socket. Or the socket can have too much over coverage, and sometimes it can actually result in even a normal head impinging on the socket. And then as I talked about previously, too much laxity allowing too much movement can even cause a normal hip to impinge.

And all these three different ways of causing impingement can result in the labrum becoming torn, and when the labrum is torn it can become painful and less in lubrication and potentially result in arthritic symptoms because of increased friction of the hip. I've tried to show what this is basically like by taking an MRI and actually overlaying an egg shape to it, which would simulate what the head would be like. Now if you can imagine this head going up into flexion. It would first of all, start to push, as Dr. Kenney will illustrate, onto the red portion of the labrum in the anterior, what we call the "front of the socket." This can result in pain in and of itself. But if this happens repetitively for years, it can actually result in the labrum being torn off of the articular cartilage. And once the tear has occurred, then it actually causes significant pressure on the front edge of the articular surface, resulting in arthritis.

So hip impingement basically presents the patient who is limiting their activities by pain, particularly flexion, and they have failed conservative measures, and they're difficult to discern whether these are simply due to impingement because other conditions can simulate hip impingement. We need to have different ways to very clearly understand whether it's from hip impingement or from, example, a back problem or other type of problem related to the groin anatomy.

So we have actually several helpful tests, and the most predominant ones that we use are X-rays, which can be very helpful if shot in the right projection. In this particular case, the lateral view so we can see the front edge of the neck and head and the socket, as well as the back edge and we can compare and what we call "MRI arthrography," which is basically an MRI after the hip has been injected with a fluid that's a special dye that you can see on MRI, which outlines the labrum nicely. And also at the same time, we inject local anesthetic in the same syringe, and that can actually be very helpful because then we can eliminate any pain for even a short period with a duration of the local anesthetic, and that will tell us that whatever pain is being relieved is coming from inside the hip capsule and frequently is impinging situation.

Now I'd like to have Dr. Kenney actually illustrate a few of these details about X-ray and MRI, and so I'm going to ask him to point out some of those finer points for us.

Thanks, Dr. Simenstad. Now the role of imaging and the diagnosis of hip impingement is multi-factorial. We can identify other causes in the patient's hip joint, which may be causing their hip pain. And in patients with impingement, we can look very closely at the different shape that their hip joint and socket has. Typically we usually start with X-rays, followed by the MRI, and at the same time as the MRI, as Dr. Simenstad pointed out, we do do that pain injection.

Now this is a diagnose gram from the literature, and on the top you can see there's normal hip, and then below that there's the pincer-type hip, which is a problem with the socket, and below

that the problem with the head. Now let's start on top. This is a diagram as though you're looking at the hip joint from the patient's feet. Here's the front of the socket and here's the back of the socket. You can see that the head has a nice round configuration. The socket covers the head well but not excessively. And then you can see that there's a nice tapering or narrowing that you see where the head joins the neck, particularly on the front part.

Now in the this part of the diagram when a normal patient puts their hip through a range of motion, there's no abnormal bumping of these structures. There's no collisions inside the joint. Now compare that below here to the problem with the socket that we refer generically to as "over coverage." In this patient, the hip is tilted abnormally so that the anterior part of the hip joint overhangs too far, and when that same patient puts there hip through a range of motion, they can have two different areas cause problems. First off, this part anteriorly impinges on the neck causing labral tears and cartilage damage in this location. And then posteriorly you can see that the head is levered out the back and it can cause tears and cartilage damage here.

Now finally the type of impingement associated with abnormalities of the head or neck is referred to an "cam impingement." And on this diagram you can see there's a large bony bump that's outlined in gray that is the so-called "cam lesion." And when this patient moves, this bony bump is what's banging into the front of the hip joint, causing those tears in the labrum and damage to the adjacent cartilage.

Now let's take a look at a couple of radiographs. Typically X-rays are the first test that's utilized to evaluate any patient with hip pain. We can look for the other cause of their hip pain, whether they're bony, or in patients with impingement we can look at the shape of the hip joint. In patients with cam impingement it's the abnormality of the head or neck, as we talked about, and then in patients with the pincer-type impingement, it's an abnormality of the socket, where the socket is abnormally tilted or perhaps it's just too deep.

And let's look at a couple of X-ray examples. Here is a patient who has the so-called "cam-type femoral acetabular impingement." You can see that the head in this patient is very large. And on this lateral view you can see that the front of the hip joint there's a very prominent bony bump compared to the backside, which is scooped out normally.

Now this structure, this bump has been chronically impinging on the rear of the acetabulum here, leading to cystic changes in the head -- you can see that bone irregularity there corresponding to the cyst -- and calcification along the rim of the socket here, either within the labrum or it can be frank fracture in that location.

Now below, we have a diagram from the literature, and you can see they have outlined what you would expect to be a normal hip joint. There's a nice round head, and you can see in the dash line they have outlined this abnormal bone protuberance that causes that cam impingement. Now off this groin lateral view that Dr. Simenstad talked about, we measure a number of different angles and measurements to help give us an idea of just how large this bony bump is and how much bone Dr. Simenstad is going to expect to encounter at the time of surgery.

Now in patients with cam impingement the other term that people will commonly talk about is the so-called "pistol grip deformity." And you can see on the X-ray here on the left there's a fairly prominent but relatively smooth bony bump, and then in comparison to a water pistol, and antique pistol, you can see that that shape of the head and neck mimics the shape of a grip of a pistol.

Now let's compare that to the pincer-type impingement with a problem with the sockets. We have a number of diagrams here. At the top we're talking about the abnormal tilt, and at the bottom we're going to show too deep of a socket. Now this is a normal patient, and you can see in the dotted line they have shown the two walls of the socket. Here's the anterior wall and here's the posterior wall.

Now with that anterior wall further medial from the posterior wall, when this patient moves, this forms a nice clearance so that that head and neck can rotate in and around the hip joint. In this other patient, where the acetabulum or socket is tilted abnormality, when we outline those same walls, you can see the so-called “figure of eight” or “crossover” sign, where this anterior wall at the far top of the joint overlaps and extends lateral to this posterior wall, and it’s this overhanging rim of bone that bumps into the femoral head and neck causing the patient symptoms.

Now at the bottom with too deep of a socket or the so-called “Protrusio deformity,” you can see that this socket is very deep. It covers all the way down into the patient’s femoral neck. And when this patient moves their hip, this whole acetabular rim can impinge on that neck area causing problems.

Now as Dr. Simenstad had talked about, the MRI is typically the best test for evaluating these patients with suspected impingement. Now we typically accomplish that with an injection inside the hip joint. And the reason for that is relatively simple. In a normal hip joint or a joint without much of a joint of fusion, there’s only a few drops of fluid in the normal hip joint and the structures are fairly collapsed against one another. Now by introducing a small amount of fluid, we can space those structures out, and that fluid tends to track into the areas of the labrum that may be torn or the cartilage that might be damaged. And we’ll look at a few examples of that right now.

Here is a case of cam impingement on an MRI arthrogram. This is a frontal view, and this is a view of the hip as though you’re looking up from the patient’s feet just like those diagrams. Now here you can see clearly they have a very pronounced pistol-grip deformity. Instead of being a nice small black triangle, the labrum is very flattened and irregular, and there’s some fluid tracking up underneath that.

Now when we look at this other view of the hip and we look at that front of the hip where the head joins the neck, you can see this very large ridge of bone, and when this patient moves their hip, that ridge of bone is going to impact right here along the hip joint. And you can see that unfortunately this patient started to develop some early labral tearing and early cartilage damage in that area.

Now while typically we do make the distinction between the cam and the pincer, in other words the head or the socket problems, in reality many patients with hip impingement actually have a combination of the two, and this is an example of that, the so-called “mixed impingement.” Here we have a view from the front, and you can see that the patient has a very prominent pistol-grip deformity on this part of the head, but in addition to that, the acetabulum is very deep. It covers all the way down to the femoral neck.

Now if we look at these two views taken from the bottom of the patient as it was looking up, this is the labrum. This should be a very small black triangle. You can see that it’s torn, it’s detached from the rim of the socket, and this bright material here is that contrast material that’s tracking into the tear of the labrum. We can see it’s torn in the front, it’s torn in the back, and on this other view we can also see that it’s torn there in the front.

Now for the selective injection, that’s the pain test that Dr. Simenstad referred to. And before Dr. Simenstad or a patient are going to embark on a surgery to try to correct the impingement problem, it’s impairment that we confirm that the patient’s pain is, indeed, coming from the inside of the hip joint. We accomplish that fairly easily under X-ray guidance. And you can see we have an image here from an injection.

After giving some numbing medicine, we slide a small needle down to a particular part in the hip joint. We inject a few drops of iodine contrast that you can see pooling here normally in the hip, and after we know we’re in the right spot, that’s when we fill the hip joint up with approximately 10 to 12 milliliters of fluid. Now in that fluid we typically have the MRI contrast and the local anesthetic, and the patient’s results of that pain injection is very dramatic. In patients with

impingement prior to the injection, they'll have very severe pain, particularly when the hip is placed in a very specific position, and then after the injection, within a matter of seconds or minutes, the pain is generally completely resolved.

And on this slide I would just like to remind people what we're hoping to avoid. Here we have two patients. You can see that they have very large bony bumps and bone spurs forming because they have gone on to develop severe degenerative arthritis of their hips from unrecognized or undiagnosed impingement. And I'll turn this back to Dr. Jacobsen.

Thank you, Dr. Kenney. I'll remind the viewers that you are able to send questions to the panelists if you click on the button, "Ask a question." Please do that as soon as you can. We have now heard about the anatomy of impingement. We heard about the symptoms. And Simenstad, what can be done about that if you have impingement?

Thank you, Dr. Jacobsen. There are several things that can be done about it, and it depends, as we said before, where you are in the continuum of the process. If you're early in the process or it's been discovered early, before damage has occurred to your hip joint and significant arthritis has occurred, there's a certain set of options, which we call the "nonarthroplasty options, which don't include a replacement surgery. Then there's another set of options, which are the arthroplasty options if the symptoms have gone on and the progression of the process has gone onto develop severe arthritis. And so we're going to talk about both of these cases.

First of all the nonarthroplasty options. There are several options, but the one that is probably considered the quote, unquote, gold standard or the one that's been around the longest is the one called an "open dislocation" with a trochanteric flip osteotomy. This was discovered or described by Dr. Gonce in Switzerland many years ago, about 15 years, and he discovered that you could actually dislocate the hip and expose the entire hip joint by doing a special approach, which would preserve the blood supply to the head. He published these reports, and then actually others here in the United States subsequently published their report, which had very good results with the surgery.

And the surgical exposure does nearly expose the entire hip joint and allows for treatment of almost all nonarthroplasty options, and it can be done relatively easily through this approach once it's done. It also can be converted to a hip resurfacing if need be during the procedure if one encounters more arthritic change than one had suspected on X-ray or MRI. But lastly it preserves the blood supply to the head, and this is extremely important when exposing the hip joint, because this avoids problems such avascular necrosis of the head, which can result in a arthritis itself.

Now some other options that are evolving are limited incision or small incision-surgery and arthroscopy of the hip. The problem is is that they are evolving and that they still have relatively difficult to perform and visualize and treat all problems related to impingement. And actually there's a few published reports on the outcomes of these procedures.

Now lastly, they can't intra-operatively be converted to resurfacing if a significant arthritis is encountered during surgery. Another nonarthroplasty option, which is only really applicable in very rare cases of over coverage pelvic osteotomy, but mostly the options are related to the first option that I described.

We'll also talk about total hip resurfacing. This is for the patients with impingement that have essentially gone on to develop such severe arthritis, or they can be other patients that result in arthritis from other causes. But it essentially means capping the head and by doing it through the impingement approach or the trochanteric flip approach, one can preserve the blood supply to the head if done through this approach. And also, one of the advantages to total hip resurfacing over total hip replacement is it restores more normal hip mechanics for most patients, and it allows the

young patient to return to unlimited activity, probably at a higher level than they could with a total hip replacement.

The two procedures we'll show today, as I stated before, are the open dislocation through a trochanteric flip osteotomy. As I stated before, this does preserve the blood supply to the head by the nature of the approach. And to do so it means detaching the muscles of the hip temporarily by cutting the bone where the muscles actually attach to the hip. And later that bone is attached the screw fixation and is allowed to heal bone to bone so that the patient has normal muscle function after it is completely healed.

Now to describe this approach a little bit better, I'm going to show you some drawings from the literature, which basically shows where the osteotomy is done. I'm going to have Dr. Kenney point to this dotted red line, which is where the osteotomy is done, right below the attachment of both the muscle coming from below and above to the hip. You can see the artery going into the neck of the femur and going to trochanter, and the head below that.

So our goal is to actually just slightly detach those muscles by removing that 15 millimeters of bone intra-operatively. You can see here's the saw cut performed diagrammatically, and then finally that muscle is then flipped, quote, unquote, with the bony attachment to the front of the hip socket and actually exposing the capsule underneath it, as will be pointed out by Dr. Kenney. And then we can incise the capsule and dislocate the hip and do the operation that we need to do.

Total hip resurfacing, just as a summary, was done probably about 30 years ago or longer in the United States but fell out of favor because of the implants used. At that time, they were plastic on metal implants and had significant wear associated with them. They were redesigned and introduced in England about 15 years, and reintroduced with metal-on metal bearings, and they have become popular in the European arena. But recently, in the last three to four years, have been done here in the United States more frequently.

And resurfacing can be done through a standard hip incision, although this can compromise the blood supply to the head in the process, or through the trochanteric flip, as I'll describe. I feel that the trochanteric flip has advantages. One is it's easier for me to position the implants, I believe, and the exposure is quite good, and then also it preserves the blood supply to the head, which is what we're actually placing the cap on, so I believe that's important.

The first case we're going to show, though, is just an impingement case. This was caught relatively early in the phase of impingement in a 30-year-old who did not have a labral tear but had significant pain with walking, as well as pain extending back at least about five years like this and probably even back as far as he teenage years if carefully questioned. The groin pain was completely relieved with injection, and she has some mild hip dysplasia on her X-ray. I'm going to have Dr. Kenney actually illustrate those finer points on her X-ray now.

Here you can see we have two X-rays on this patient. This is a frontal view for the whole pelvis and then this is the groin lateral view that Dr. Simenstad had talked about where we're looking up at the hip joint to show the front of that head/neck junction. And you can see on the frontal view the head is nice and round and the neck looks nicely contoured, and there's not a real dramatic abnormality with the socket portion of the hip joint. But as we move to that groin lateral view, you can see that as compared to the back of the head/neck junction, which is nicely scooped out and contoured, there's a fairly prominent but shallow bony bump here in the front, and that's the cam lesion that's resulting in the patient's symptoms.

Thank you, Dr. Kenney. Could we roll the video. I'd like to show some video of the surgery. First of all you're going to see -- the video will start out, and this is the left hip, and the camera is positioned at the head of the patient, and so we'll be seeing, first of all the spinal anesthetic inserted, because we like doing this procedure under spinal. As Dr. Conterato will describe later,

we use regional anesthesia extensively during these procedures. So the spinal is inserted, and the patient's positioned on their side, and the head of the patient is to the right of the screen and below, and the foot of the patient is above.

You can see we incise the skin to about a six or seven-inch incision and then elevate the bursa and then expose the muscles. As I say before, we isolate the lower muscles and now we're isolating the upper muscles, and then you can see now I'm using electrocautery to mark along the trochanter that spot that we showed with the red dotted line on the previous diagram.

Now I'd like to cross hatch or with a little chisel just barely score the area so that we can easily match those two edges up later for a perfect reduction of osteotomy. And then also it's helpful to pre-drill the osteotomy, which also aids in reduction and helps us put the osteotomy right back in the previous place, because the screw tends to find the track that's been pre-drilled. Then with a very thin oscillating saw, the osteotomy is performed. We're very careful to stay in line with the previous cut, and the cut will be completed here with the saw.

And then an osteotome is used to just finish the last little portion by elevating the up the trochanter. You can see that small 15-millimeter portion of that trochanter being elevated. Then we'll flip the trochanter to the front, and that's to the right of you, and you can see the pre-drilled hole in the trochanter there.

Next we are going to just above that area incise the hip capsule. You can see the bump now starting to be exposed where this patient has her impingement coming from her cam-shaped head. And if you look right at the tip of the scalpel you'll start to slowly see the labrum be exposed at the very top of the head. There we start to see just the edge of the labrum, and then we direct the capsular incision towards the back, just in front of the labrum. You can see the labrum just barely at the edge of the scalpel.

Then we dislocate the hip, and you can see the bump right near where the sucker or the suction catheter is. And you can now see the bump also outlined right there in the middle of the screen, and also I touched it with my finger. And then what we'll do is carefully trim away the bump with hand instruments, being very careful to avoid any of the blood supply laterally, which is to the left of the head, which enters into the neck of the femur just below the head.

We carefully chisel away this area, and note the bleeding which is occurring from the bone, indicating that the blood supply is still intact to the head. You can see this on several occasions when we clean the cut surface and you can see the blood immediately come back to those areas. Now we have put the head to the back of the socket so that we can expose the entire socket and actually probe with the probe the labrum and make sure that there isn't a tear in the socket, and then we reduce the hip. And you can see when the area is suctioned right in the area where the osteochondroplasty is performed, you can see that there's good clearance between the neck and the labrum itself with absolutely no impingement occurring.

And lastly what we do is close the hip up and repair the attachment to the muscle. You can see now we're bringing the attachments back in, looking at the cross hatch marks and lining the screw up. So the first screw will go back into the pre-drilled hole that you saw earlier in the video, and then usually we'll have three screws to reattach the trochanter. And the three screws will secure the trochanter nicely, as you can see here. And then we will send the patient to the recovery room following that after we have closed up the rest of the incision, and then the patient will be in the hospital about two to three days after the procedure, toe-touch weight bearing or limited weight bearing for about six weeks to make sure that the trochanter heals. Then after it's healed, then they can return to full activities. And this is the post-op recovery room film showing the osteotomy and the three screw fixation, with the repair.

Case number two is a 45-year-old female who unfortunately was discovered to have hip impingement a little late for treatment with the osteochondroplasty option. And she had

significant arthritis already. She has very severe pain with walking and with the pain walking and the pain is perceived in her groin. And her x-rays show end-stage acetabular impingement. She's failed conservative measures. She's a physical education teacher so would like to return to a high-activity level as soon as possible. So even though she was confident about total hip and total hip resurfacing, she chose total hip resurfacing to be more active than she could be with the total hip. I'm going to now put her X-rays up and have Dr. Kenney outline her examples of femoral acetabular impingement and how it resulted in the arthritis.

Now here you can see on the frontal view that she does have fairly end-stage degenerative arthritis. This is the ball, and here is the socket, and you can see that these two bump right up against one another. This is the bone-on-bone situation where there's no cartilage remaining in this area. Now you can see that here she has a fairly large bony bump here and some bone spurs that have grown. And then this is the acetabular rim that you can see is fairly prominent in location. It doesn't really overhang on this view, but if we switch to the view where we're look up from the patient's feet, you can see this large bony prominence. That's too big. The socket comes over too far, and you can also see a very prominent bony bump at the front of the femoral head. And unfortunately this chronic long-standing impingement is what's led to this patient's very severe degenerative arthritis at a very young age.

So what I'd like to do is go to our video and we're roll to the video. And this will be actually a right hip, so we will be looking at the patient from below the patient. And here is the incision. And we have done this patient under spinal anesthetic too. And I have skipped actually to the area where we do the osteotomy because we showed you the approach already on a previous patient. So I'm skipping to the area where we use the saw and perform the osteotomy. We've already pre-drilled. We've already done the cross hatching to enable us to adequately reduce this back into its original position at the end of the procedure.

So the saw is actually brought almost all the way to the other side of the trochanter and then the very last little bit we're going to actually do with this osteotome manually. You can see we pop it to the front, and that's where the name "flip" actually comes from. We actually flip the trochanter to the front of the hip socket. You can see the capsule right now, which we're incising in this patient with arthritis. And then we dislocate the hip, and notice this extensive arthritis involved in the head, and osteophytes all around, which we're going to first of all remove with the Rongeur to get better visualization of all the landmarks.

Now this particular case we used computer navigation, so you can see a pin that's essential for sending a reference point for the computer for computer navigation, which is secured to the patient's femur around the lesser troc. And then what we do is use a marking device, which has those three silver balls on it, and trace out the head of the femur so that the computer can see exactly the three-dimensional contour of the head.

Now that the computer has those dimensions we then bring in our drill guide. And the idea for hip resurfacing is there's a central pin that needs to be very accurately placed on the center of the thermal head and neck. And so you'll see that we're spending considerable effort to make sure that that pin is in the right place. So first of all we line it up with the manual instruments and then use -- at the same time we can also use the computer to reference our check, and you can see that now I'm bringing a drill guide in that had the silver balls on it, and the computer told us that, yes, indeed, the pin was in the center of the head and neck.

Now we use a manual device to actually make sure that the clearance of the size that we've chosen for the head will not cause any damage to the femoral neck and will only shave off the outer aspects of the head. Next, we over-drill that guide pin with the bigger drill. And this drill allows us for us to insert a post, which will guide the next several cutting devices to reshape the head to the exact contour of the capping device or the resurfacing head.

So this is a cylindrical reamer, which will remove just the outer periphery of the head, and very carefully we're directing this reamer,. We obviously don't want to go too far with the reamer so we're careful with the last little bit to see how much we have left, and then the last little bit of the trimmings around the head are removed. And then once we've done that, the debris associated with that is removed.

You notice we have a drape around this whole area to keep the debris from entering into the wound as much as possible. A top cut is then performed from this napkin ring guy, which basically removes the top eight to ten millimeters of the femoral head. And once this is completed then we want this to be perfectly flat, and so we reinsert the post and then a planing reamer is inserted over the post, as you can see. And then this planing reamer ensures that the surface of the top of the femoral head is perfectly flat, and so this is the device now being utilized.

The last step associated with reshaping the head to fit the inner portion of the resurfacing head is the chamfer cutting device. And this will actually form what we call a "chamfer cut," as you will see, and it's slowly inserted. It's a very sharp cutting instrument, and it's inserted onto full power. And as you see, the last little bit of the head edges are removed with that, thus making it completed for the inner and ready for the capping device.

We do the head first because it gives us better exposure of the socket. You can see the head is off to the left now and being retracted, and the entire socket is well exposed to this trochanteric flip approach. And then I just removed the labrum and that osteophyte that was overhanging that Dr. Kenney had described.

Then we bring in a spherical reaming device, and it's done in sequential steps from a small size up to a bigger size. Once we feel that the entire socket has been reamed adequately so that it can then obtain an acetabular component or the socket piece, then this is brought into place. And this has porous coating on it so the patient can grow into this side. This side is placed uncemented, and then you can see it being impacted into place until it is fully seated, and then we check to make sure that it's secure.

Now you can notice on the left the femoral head has a trial device on it, which is important. You can see that socket is in place there. The trial head is actually marked right at the base of it so that we can ensure during impaction of the capping portion or the resurfacing head that it is fully seated all the way down onto the head. And then drill holes are created in the top of the head and around the side to allow for intrusion of cement, because in the United States most of these heads are actually cemented in place. And then we wash all off the debris so make sure that the cement can be directly intruded into the bone.

The cement is placed into the head, as you see here. The head is applied to the cut surfaces of the head that we have previously prepared and then the head is impacted and cement is wiped clean, and we impact it completely until it has reached the marked area of the trial device. Then the hip is reduced, and basically the arthroplasty is near complete. We close the hip capsule with suture, which you see there. And then, of course, reattach the muscle attachments, as we did with the impingement procedure. And these are brought back with the cross hatchings matched up perfectly and with the screw also going in the pre-drilled screw hole, which also helps with the accurate reduction of this piece. You can see that screw is inserted all the way first, and then we add two more screws in addition to that and then check for stability of the trochanteric fragment. You can see all the screws have been inserted now. And then check with the scalpel just to make sure that a very accurate and tight reduction has been performed of the trochanter.

Now this is the -- I'd like to roll to the PowerPoint, and this is the actual X-rays of the patients you can see on the monitor after surgery of this particular patient. We can see that the resurfacing device is well placed with the stem directly in the middle of the femoral neck, and the three screws are actually securing the trochanter.

Thank you, Dr. Simenstad. We basically heard about two procedures, one for impingement where there is a incongruency between the ball and socket. And what surgery accomplished is basically making the joint congruent again, hopefully preventing further arthritis or any arthritis to develop. And the second procedure, resurfacing, where only the ball or the hip joint is capped, and much less bone is resected as in conventional joint replacement.

A big concern from a lot of patients going into surgery is anesthesia and about the pain management or the pain level after anesthesia of the postoperative phase. And Dr. Conterato, what's your approach to that?

Thank you, Dr. Jacobsen. Certainly I concur with you completely. Patients have a great concern about the amount of pain they're going to experience following these types of procedures, and it can actually be an obstacle to them considering undertaking these options early enough so that they can preserve the joint. Pain relief is rated one of the top concerns the patients have coming into major orthopedic procedures. And fortunately at Saint Joseph's Hospital at Marshfield Clinic, we employ advanced techniques of regional anesthesia or nerve-block anesthesia to provide excellent pain relief to these patients in the post-op period.

The traditional approach to hip surgery and total joint surgery in general that have been taken on in the past was to use opioid or narcotic-based regimens of pain relief. The problem with these is that they have accompanying many side effects that are detrimental to the overall wellbeing of the patient in the hospital. Certainly when significant amounts of narcotics are used, which is often necessary for this type of surgery, sedation is a major side effect. In addition, the sedation can be so profound that respiratory depression ensues, and we have to try to intervene to try and help the person breathe at an adequate level.

Nausea is an extremely common side effect of narcotic medications and is one of the things the patients actually fear the most with surgery postoperatively. Additionally, constipation, urinary retention are very common, and one of the more important things also is the pain is not well covered for what we call "evoked pain," that is to say, the type of pain that occurs with movement of the joint and when the patient is first getting ambulatory or engaging in physical therapy in the first several days postoperatively.

There are several different nerve-block options then that we have employed as alternatives to pure narcotic-based regimens that enable us to treat the pain. Initially what had been used in the past was what's called an "epidural catheter infusion," which is a small tube about the size of a piece of fishing line that is inserted adjacent to the spinal cord and coats the spinal cord and exiting nerves that go to the hip with local anesthetic and often with small doses of narcotic medication.

The problem with this is this is also a very vascular area with fragile veins coursing through it. And the more recent approach to the peri-operative management of these patients is to be very aggressive about preventing post-operative deep venous thrombosis or blood clot in the legs. As a result of that, this also puts the area where we have gone in with the epidural catheter at risk of bleeding or on the spinal cord, and the outcome can be disastrous in terms of entry to the spinal cord, numbness, paralysis, and other neurologic deficits that occur.

Additionally, these patients have urinary retention and are not able to really do much in the way of walking with crutches as a result of having both legs numbed up. What had been tried in the past as an alternative to that is what's called an "epidural single-shot injection," where instead of putting any significant amount of local anesthetic in, through a single injection in the epidural space, a long-acting preparation of a narcotic call DepoDur was placed around the spinal cord to coat these nerves and given them pain relief. But the problem is that the same narcotic-related side effects that we had discussed with the intravenous approach are also experienced with the epidural single-shot approach, and again, this has not been a very satisfactory technique and is associated with a lot of side effects as people get older.

The nerves that constitute the lumbar plexus, which is the major nerves going into the hip joint are the second, third, and fourth lumbar nerves. The femoral nerve constitutes L2, 3, and 4, but unfortunately it is a little bit beyond where the nerves start to branch off into the hip joint. A continuous femoral nerve block had been employed in the past, but the coverage was less than satisfactory. By coming closer to the spinal cord area but not actually being in the spinal column we can place a small catheter similar to an epidural catheter in the plexus of nerves buried in the psoas muscle as they course from the spinal cord or vertebral column area to the hip joint, and this is the major technique that we employ at Saint Joseph's Hospital Marshfield Clinic.

Multiple perspective studies have been done looking at this, as well as what we call a meta-analyses. And a meta-analysis is where we compile all the data from multiple single studies and get much larger numbers to be more statistically relevant. And on a consistent basis, there has been a clear advantage of continuous lumbar plexus blocks in terms of the quality of analgesia, lower incidents of side effects, and attaining the physical therapy goals that we would like to achieve in the first several post-operative days.

The analgesia that we see with this is clearly better than that we achieve with epidural catheters and with the femoral nerve blocks, and there is lesser degree of motor block than with those lesser two techniques, so, again, the patient is able to be up crutch walking and doing some partial weight bearing in the first couple of days, as well as being able to tolerate what we call, "evoked movements" with the hip joint, and their pain with movement is much less.

Is also compatible with the more aggressive modalities of peri-operative DVT prophylaxis that we use, and we can safely have that catheter placed in the psoas muscle without concerns about ongoing nerve damage like we did in the epidural space. So this constitutes a pivotal point of our component of multimodal analgesic regimen that includes running a lumbar plexus catheter infusion for the first 48 hours, as well as scheduled Gabapentin, acetaminophen, and as needed, doses of narcotics orally.

This is a diagram demonstrating how we approach this. Typically what happens is the patient is sedated so that they are comfortable and tolerate this procedure very comfortably. The area is prepped with a sterile solution and then draped off. And after anesthetizing the overlying skin where we're going to approach it, what is called a "stimulating catheter needle" is inserted about four centimeters lateral to the middle of the vertebral column. Those three circles you see or ovals you see in the middle represent the mid line of the spine or about four centimeters to the side on the operative side of the spine, entering into the psoas muscle.

We pass a very small imperceptible amount of electrical current on an intermittent basis through this needle, and when we come in close proximity to the nerves of the lumbar plexus, we actually evoke the motor responses that those nerves convey; that is to say, we will see twitching out of the thigh muscles, demonstrating that we are in the plexus area that we want to place the catheter in.

This is a cartoon demonstrating the location of the lumbar plexus nerves, so we have the lateral femoral cutaneous femoral and obturator nerves. Dr. Kenney is demonstrating that right there. And what you see is there's a fascial plane or compartment within that psoas muscle wherein the lumbar plexus runs and we're able to pass a catheter and run a continuous infusion.

This is just a dissection where much of the psoas muscle has been peeled off, demonstrating that all these nerves of the lumbar plexus run within the same plane so that if we can get a catheter into that proper plane, all these nerves will be bathed with local anesthetic. Again, this is just another illustration of the same fact.

Dr. Kenney is demonstrating the small catheter coursing through the subcutaneous tissue and muscle to lie within that fascial plane where the lumbar plexus runs, and we have injected a small

amount of X-ray contrast die that highlights the entire lumbar plexus, showing that even small amounts of local anesthetic give us wide coverage of the nerves going to the hip joint. One of the benefits to this is that the patient is now able to engage in physical therapy and is quite comfortable in the recovery room so that we're able to progress with a much more rapid and efficient therapy for the patient post operatively.

Thank you, Dr. Conterato. We'll basically say, can the patients be pretty much pain-free after surgery, do you think?

The benefits that this have are tremendous. Obviously you can never guarantee someone that they're going to be a hundred-percent pain free. What we explain to the patient is that typically using this block -- and we use a numeric pain scale rating pain from one or that is hardly perceptible at all, to ten, being the worst pain they can imagine. Typically the pain is often at an eight to nine level after this type of surgery. But with an effective lumbar plexus block, more typically it's at a two or a three. And using the other oral coanalgesic medications that we talked about, the pain is extremely well managed, and the patients are very satisfied.

That's encouraging. So the post-op pain management that you and your department are doing, does that differ from other centers in the region?

We are unique within Central Wisconsin with this type of program. These are much more advanced techniques of regional anesthesia; the type of training that requires fellowship level of training and is not typically found in many areas throughout the United States and in Wisconsin. We're very fortunate at Saint Joseph's Hospital Marshfield Clinic to have a group of individuals who are skilled in these types of techniques so that we can consistently offer this type of pain relief to patients postoperatively.

Typically, you only find this at hospitals that are associated with teaching centers or research centers, but at the Marshfield Clinic we have actually generated a very large regional anesthesia program and is probably the largest in the state at this time.

Thank you. Dr. Simenstad, what role does the pain management play in the recovery for your hip surgery?

It's a very integral role. Patients that are not having significant pain after surgery are able to participate in physical therapy much more readily. They're much more satisfied with their hospital stay. And lastly, many of these patients are probably able to go home much sooner, some of them as soon as two day after surgery, and many within three, mainly because of this pain management program that Dr. Conterato outlined.

What is rehabilitation following surgery for the three procedures, for the resurfacing, and then the flip procedure, and the impingement surgery.

Well because of the trochanteric flip osteotomy needs to heal, we actually do recommend about toe-touch weight bearing for the first six weeks so that the hip abductors don't see too much stress. But once they're healed, then we allow any activity as the patient's can return to completely normal activity at that point.

That's great. Dr. Kenney, you're a radiologist and you see a lot of hip X-rays on a daily basis. And you must often see quite a few hip impingements. How often is it you see a hip impingement when you look at X-rays, and do you think all of them are symptomatic to have pain?

It's very common when we look at X-rays of patients with hip pain that they do have those abnormal shapes. Either the head is abnormal or the socket is abnormal. But it's important in making the diagnosis of actually the whole impingement syndrome that we also, you know, strongly consider the patient's clinical scenario. You can imagine a patient may have an

abnormally-shaped head or socket where they may, in general, be predisposed to having impingement, but if they're not very active, they're not going to bring about that pathology; whereas another patient with relatively subtle changes, if they're very active, cycling or playing hockey or something, they might have a lot of symptoms. So we do see it very commonly and theirs is a significant percentage of those patients that do have the hip impingement symptoms.

Thank you. And Dr. Kenney, every patient with hip impingement who are going to have surgery, do they need an MRI? Do they need an injection, as you mentioned before?

Yeah. It's very critical to the evaluation of these patients that they have the MRI. And generally, before someone's going to consider surgery, they're going to need the pain test part of the injection. So we put the two together. We do the MR arthrogram. And they need the injection prior to the MRI, so we instill the local anesthetic at the same time. Now on occasion, a patient gets referred in where their MRI may have been done without an injection, and if we see all the typical findings and the labral tears and whatnot, then it may not be necessary to actually repeat the MRI. But generally they will come back for that pain test injection.

Thank you. Dr. Simenstad, are most orthopedic surgeons familiar with impingement? And the question is also, "How can it be diagnosed easily? If a patient comes to you and just wants diagnostic test you see that will be the most significant?"

Well, it's becoming more and more common and understood by orthopedic surgeons around our area, as well as throughout the country. And to answer the second part of your question, the single-most important test is actually the one Dr. Kenney actually outlines, is the one select injection. Obviously you need to have X-rays to support it and an MRI that supports it. But it's absolutely critical that the patient receive relief from their pain from the injection into the joint itself, which indicates that there's some cause inside the hip capsule emanating their pain.

So if I had to say one text is the most important, it's the injection test for me, but MRI are very important, and X-ray as well.

Dr. Simenstad there's a question for you. Isn't hip resurfacing losing favor recently?

There's been some articles in the literature about some of the problems related to hip resurfacing. But I don't know that it's actually losing favor. I think that it actually needs to be applied carefully, and actually the articles that were written were actually simply outlining some of the restrictions that were recommended two or three years ago, relating to small females, and the risk of fracture of the femoral neck was higher with small females.

Also, patients should have selection in regards to their BMI. Patients with BMI over 35 are not good patients for this surgery, either through the trochanteric flip or through a posterior approach. And so what we're seeing now, I think, in a popular lay press is actually some of the information that a lot of us surgeons knew; that this operation is not for everyone and you do have to be selective. And it's generally for younger patients. It's not for older patients that have poor bone or osteoporosis. Those operations are best done with a total hip replacement, and so generally this is for younger patients. But it's for patients that want to have activity levels that are more aggressive than with the total hip.

Thank you, Dr. Simenstad. I think we are out of time now, and I would like to thank the audience for joining us here today and supplying questions for us. I would like to extend a special thanks to our patients who agreed to have the procedure videotaped, and I would like to thank my colleagues for joining me here tonight. Thank you. Goodnight.

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