# MINIMALLY INVASIVE HIP REPLACEMENT SURGERY FOR OSTEONECROSIS
GOOD SAMARITAN HOSPITAL, BALTIMORE, MD
Broadcast July 20, 2004

NARRATOR

Welcome to the live internet broadcast of a minimally invasive hip replacement surgery for osteonecrosis from Good Samaritan Hospital in Baltimore, MD. Today Dr. Marc Hungerford, Division Chief for Johns Hopkins Orthopedics at Good Samaritan, and Dr. Harpal Khanuja, Assistant Professor of Orthopedic Surgery, will perform the procedure.

HARPAL KHANUJA, M.D.

An MIS procedure for total hip replacement, MIS refers to minimally invasive surgery. There's two days to describe that. Typically what is being performed by most is a smaller incision where you do less trauma to the surrounding tissues and hopefully speed up the patient's recovery time.

MARC HUNGERFORD, M.D.

The recovery time for a total hip replacement is fairly quick. We allow the patients to bear full weight on day 1. We get them up out of bed and walking on crutches or a walker on day 1. We do like to keep our patients on crutches for a period of 6 weeks to protect the soft tissues while they heal. Most patients can return to driving a car after 2-3 weeks. Patients with sedentary jobs can return to work after 2-3 weeks. Patients with normally active jobs, where they do a reasonable amount of walking, usually have to wait 6 weeks to 2 months before they can go back to work.

NARRATOR

The event will be moderated by David Hungerford, M.D., Professor of Orthopedic Surgery at Johns Hopkins Orthopedics at Good Samaritan Hospital, who has been at the forefront of research, treatment, and education about osteonecrosis. Approximately 20,000 new patients are diagnosed annually in the United States with osteonecrosis, primarily afflicting those in their 20s, 30s, and 40s. The disease has also been shown to be associated with lupus, sickle cell disease, Gaucher disease, as well as with steroids and alcohol use.

DAVID HUNGERFORD, M.D.

The future for osteonecrosis will be that we will have better means of identifying the at-risk people and we'll have better means of salvaging the bones that are in the process of collapsing and I think ultimately we will have a 50-year total joint replacement and maybe not in the not too distant future that will solve the problem for the 40-year-old who's got a destroyed joint.

NARRATOR

You, the viewer, can send in your questions via email by clicking the MDirectAccess button on the player window. Physicians who log onto this webcast will receive continuing medical education credit as they learn about osteonecrosis diagnosis, treatment, and surgical options. Now your host, Dr. David Hungerford.

DAVID HUNGERFORD, M.D.

I'd like to welcome you to this live webcast at the Good Samaritan Hospital. I'd like to emphasize at the beginning that, although we are featuring minimally invasive total hip replacement, this webcast is just as much about osteonecrosis as it is about minimally invasive surgery; in fact, even more so.

Osteonecrosis is a condition, as you heard in the lead-in, that affects about 20,000 new patients a year and the economics of this, because these patients are young, are really quite devastating.

The patient who's being operated on today is a 55-year-old man who sustained a femoral fracture in 1995 and, as a part of that injury and the subsequent treatment, developed osteonecrosis, with slow collapse of the femoral head leading to the surgery that he is having today. However, the majority of the patients with non-traumatic osteonecrosis are in their late 30s and 25% of our patients are under 25. This poses a real problem and we would really like to be able to salvage these hips, allow the patient to have their natural hips rather than replace them. There are some techniques on the horizon, and we'll talk about some of those in the context of this webcast during the next hour, as we are in between different phases of this MIS surgery.

The surgery today is performed by Dr. Marc Hungerford, with assistance of Dr. Dennis Kramer and physician's assistant Joe Campbell. We'll now go and take a look at the x-ray on the patient who's being operated on today. Okay, here you see the x-ray and the templating for this patient. This shows several things. #1, you can see the upper outer quadrant of the head had collapsed. The joint space is narrowed. The markings are for the templating for the orientation of the socket and the neck cut. You can also se quite clearly that the leg is shortened by about 1 cm. The lateral view, which is the x-ray on the right, shows the typical area that's involved with osteonecrosis, whether it be traumatic osteonecrosis or non-traumatic osteonecrosis, and that is the front and lateral aspect of the hip. This has collapsed and led to the patient's symptoms, necessitating the operation today.

So now let's go to the surgery and see where we are and what's going on.

MARC HUNGERFORD, M.D.

We've already started, so we're doing this surgery in two parts. We start with a small incision in the front of the hip. Let me clean this up here a little bit so you can see. Just for a sense of scale, I'll provide my finger, so the incision is about the length of my finger. The incision is a little bit diagonal. This is the patient's pelvis right here, or the point of the hip, and the knee is down here. I don't know if you can see that. It's a little bit out of the field. The knee is down here. Now I'm doing to place these retractors here. First we make the skin incision. This fascia is overlying the muscle here and I've incised it. The reason I did it this way is there's a skin nerve that travels around the corner here and to try to protect that skin nerve, we make the incision here instead of here. That exposes the muscle. There's the muscle here. This is called the tensor fascialata, which is one of the anterior muscles of the thigh. We'll pull that out of the way and come down to our hip joint. Okay, so it's a little bit deep in the hole. I'll show you that picture there. This is the neck. Here is a lighted retractor I'm going to place behind the femoral head. Here's one and here's another one. In honor of Martha Stewart, I'd like to say that's a good thing.

So we've taken out a piece of the femoral neck, which allows us to get access into the femoral head. There's the femoral head. The femoral head is still in the socket and it's actually in there pretty solid, so when we're doing our regular surgery through a lateral approach, we're able to twist the hip and get that head out, but today we have to take a section out of the neck. He has a very large head, so that's going to make it a little bit harder to get out, but we have this device here. If you haven't watched surgery before, it is a little brutal looking. We're going to put that into the head. Let me have the mallet. The bone is very hard because it's sclerotic from the avascular necrosis. In avascular necrosis, the bone actually loses its circulation, and we'll get to that a little bit later in the presentation, but because of what has happened, this man's bone is very, very hard in this area and it's a little bit hard to put the extractor in. Okay, so now it is stuck inside the socket, so we have a lot of leverage on our side. They say that orthopedic surgeons as strong as an ox and twice as smart, and this is part of the reason why. We have to yank it out. It's just a really, really big head. It's loose, so that's a plus. There we go. Okay, so you can see that the size of the head is almost bigger than the incision we made in the skin. Everybody is breathing a sigh of relief at this point. Now, the features of this head that show you have avascular necrosis is that you can see the cartilage is all wrinkled. That's because part of the femoral head is collapsed and the cartilage over it has become damaged because of that collapse. Down here it looks more normal, even though it's worn out now, so it doesn't look that normal, but more normal than this part does. So we're going to measure our femoral head. It measures 55. We're going to place our retractors.

DAVID HUNGERFORD, M.D.

While he's exposing this acetabulum, we'll come back to him as soon as he has exposure. Let's take a look at some of the aspects of osteonecrosis that are important and why I think this is more important than the numbers might indicate. There are about 300,000 total hip replacements done in the United States per year. Of this, only about 20,000 are from osteonecrosis, so 10% or less. However, when you look at the numbers and if you figure 1% revision per year in the at-risk pool and these patients average age 40, there are going to be a large number in the at-risk pool, probably if we took very conservative numbers, 20 years x 20,000 a year, that would be 400,000 in the at-risk pool or 4,000 revisions a year. Primary total hip replacement of $20,000 is a pretty conservative price. Revision $40,000. That means the direct cost of total joint replacements in osteonecrosis would be about $560 million direct expenses. Now, consider the fact that these patients average age 40. They're in their working years. Most of them will require revision. There's considerable disability, work loss, things that they can't do after total joint replacement. This is a big economic problem. It's certainly in excess of $1 billion a year and one of the reasons that we have established an osteonecrosis research center at Hopkins, which is endowed and is looking for solutions to the treatment of osteonecrosis that don't involve total joint replacement.

Marc, how's the exposure coming.

MARC HUNGERFORD, M.D.

I need a touch more time.

DAVID HUNGERFORD, M.D.

A couple more minutes. Okay, let's go to another side which shows our understanding of why bones like the femoral head die, whereas other bones may not. That's this concept of bone functioning as a Starling resistor. Pressure increases within the bone. Because there's no concomitant increase in the blood flow, the blood flow is actually slowly squeezed out. The combination of weight bearing and the increased pressure results in death of the bone and then collapse of the bone, so we see this schematic, which shows bone functioning as a Starling resistor, which is defined as a non-expandable compartment. When the pressure increases, then the flow through the bone must decrease and eventually the bone will die.

In the next slide, you can see an actual measurement of the bone marrow in a normal bone on the left and then in a patient with osteonecrosis, where the baseline pressure is already elevated. When you challenge the ability of the bone to receive blood, the pressure goes way up. This is the rationale for the treatment of core decompressing, decompressing the bone and allowing blood flow to be re-established.

MARC HUNGERFORD, M.D.

We're looking pretty good for the exposure here.

DAVID HUNGERFORD, M.D.

Okay, we're going back to the live surgery now and show the acetabular exposure.

MARC HUNGERFORD, M.D.

This is our look at the acetabulum. You can see it's kind of down around the corner, but we have a pretty good view of it. Here is the weight bearing portion up in here. This is non-weight bearing. The rim is a rim of soft tissue that we're going to have to take away.

Our patient is quite a muscular fellow, but he's not very fat, so they kind of balance each other out. The most difficult patient to do a minimally invasive surgery on is somebody who's overweight and muscular because both of them limit the amount of visibility that you have, so in this patient we're actually getting a fairly good view. This labrum of soft tissue surrounds the hip and it will prevent us from being able to put the acetabular reamer in the proper position and to prepare the socket for implantation, so we have to take a little bit of that way, but we're not really taking anything out of the capsule. In fact, in this patient the acetabulum is in pretty good condition because his disease was mostly on the femoral side. Okay, we'll place this retractor in. This is one we'll probably change the design of, make it a little easier to get in there. Okay, we've got a good view of the superior acetabulum at this point. That's right up in here, if you can see that. This is the labrum that has to go. We'll take some of that out.

People always wonder what gets replaced when you have a "total" joint replacement. We're actually only replacing the weight-bearing surfaces and in the case of a hip replacement, we're replacing part of the femoral head and neck, so we don't replace your blood vessels, your muscles, skin, nerves, or even ligaments, except in certain instances. It's really a resurfacing procedure.

Okay, so that's about as good a shot as we're going to get.

DAVID HUNGERFORD, M.D.

So that's the acetabular exposure. Let's take a look at one of the slides that shows how this is a combination of the depth of bone and then the mechanical forces that cause it to collapse. In this slide, we see two patients, one on the left and one on the right, which is a case of post-traumatic osteonecrosis. The one on the left shows a little arrow where the lateral head of the femur used to be in relationship to the acetabulum and we see now that there's a new weight-bearing area. Over time, this weight-bearing area, which has dead bone, because of the mechanical forces that are applied to it, fractures and collapses. This is seen more dramatically in the right case. This would be the immediate post-fracture femoral neck valgus deformity, where a portion of the head has come out of the socket and that's not the portion that collapses. The portion that collapses is that area which is weight-bearing. It's important to understand, in the next slide, that osteonecrosis, non-traumatic osteonecrosis, seldom occurs in patients who are completely normal. There is a subset, maybe 15-20% of the patients, in whom we cannot find any associated risk

factors, but as we look at some of the things that are common with patients who have osteonecrosis, we find that a significant portion of them have some clotting disorder. Blood that is exposed to air clots. With injury, blood clots. Clots form in blood. It's very important that blood actually does clot. When the clots form, there's a system of enzymes that are released which dissolve the clot. In this slide, we see that thrombophelia means enzymes that lead blood to clot and hypofibrinolysis are enzymes that dissolve the clots.

So we see many of the patients with osteonecrosis have risk factors for clotting abnormalities. We think that in the future there may be some fairly simple test that can be done to identify those patients who are at risk, particularly those who have risk factors of cortisone treatment or alcohol consumption that, combined with coagulation abnormalities, may lead to an increased risk of osteonecrosis.

Let's go back to surgery. We're about ready to start the preparation of the acetabulum, which has now been exposed. The acetabulum is prepared by a reamer, which removes all of the soft tissue and exposes bleeding bone for contact with the prosthesis. The femoral head has been measured at 55 mm, so therefore, Dr. Marc is going to start with a 56 mm reamer to remove the remaining articular cartilage that is in the socket so the bleeding bone is exposed for intimate contact with the cementless prosthesis. This will be done as a series of acetabular reamers.

MARC HUNGERFORD, M.D.

There we go. That was easy.

DAVID HUNGERFORD, M.D.

It's much more difficult to get these reamers in, obviously, through a very small incision, but as you can see, it is certainly possible. This acetabular preparation will be done with a series of reamers that are increasing in size in 1 mm increments, then the surgeon will inspect the acetabulum until he's happy that all the articular cartilage and some of the bone is removed so he has a nice bleeding interface to unite to the cementless acetabular component.

While he's continuing to prepare the acetabulum, let's take a couple of the email questions. One patient has written in I've been diagnosed with osteonecrosis in both hips. My question is, if I continue to participate in certain sports, particularly running and softball, will this accelerate deterioration of the joint? The answer to that is yes, activity and particularly impact loading will increase the rate at which the bone collapses and the bone deteriorates. This becomes a relative value judgment on the part of the patient. I can't really tell a patient that they shouldn't do anything; they just need to know what the consequences are. I think for aerobic exercises, things like water aerobics, an exercycle, and things that are not weight bearing but exercise the muscles are preferable for patients with osteonecrosis. Impact loading – basketball, running, running on a treadmill, contact sports – are going to be undesirable and they are going to accelerate the deterioration of the joint.

Another question that we get which I think is very important to dispel is that this patient has osteonecrosis at one point in the body and they want to know if this will be the only affected bone or if it will spread. Osteonecrosis doesn't spread in the sense of an infectious disease that can spread from one place to another in the body. However, it does seem that way sometimes because patients get multiple joints involved. The most common joints for osteonecrosis are the hip, followed by the knee, followed by the shoulder, followed by the ankle, but osteonecrosis can actually involve any joint in the body. The rate of clinical progression is quite different, so although a patient might get osteonecrosis of the hip from, let's say, cortisone treatments or from some disease, like lupus, and osteonecrosis of the knee at the same time, the hip symptoms might appear first, to be followed by the knee symptoms maybe 1-2 years later, so it would appear to the patient that the osteonecrosis has spread from the hip to the knee, when that's actually not the case, so it's not a contagious disease. You can't get it from anybody. It does affect multiple joints and generally, when we see a patient with osteonecrosis in one joint, we are looking in one way or another at some of the other joints.

MARC HUNGERFORD, M.D.

We never made our final femoral neck cut. I sometimes wait until later to make that, but we're having a little bit of a hard time getting the acetabulum in because it's so large, so I'm going to revise the neck cut now.

We've templated this carefully before we started, so we know where the neck cut ought to be. We see a picture right there, fluoro picture.

DAVID HUNGERFORD, M.D.

One of the questions that came in is, is core decompression generally the best method of putting off total hip replacement or are there other non-surgical treatments I can try to put off surgery as long as possible? Would using crutches help buy me time to make an informed decision? Should I be tested every week to monitor progression? There's a series of questions here. We'll go to some of the other issues that deal with the attempt to preserve the femoral head. Then on slide 23, these are the types of things that need to be asked and answered in order to determine what treatment is the best for a given patient. We need to know the success rate of the treatment, but that alone isn't enough. You could have a treatment that had a 50% success rate if it was a very benign treatment and had very little risk. That's morbidity. Morbidity is basically what are the issues surrounding? How much pain, how much disability, how long associated with it? What are the risk factors associated with the surgery? What are the potential complications? Very importantly, what is the subsequent impact on total hip replacements? Some treatments, for example osteotomy, which deform the femur, can make a total hip replacement much more difficult.

Now, in addition, in the next slide, in order to determine the particular procedure that's right for a specific patient, we have variables in terms of the stage of the lesion. Is it pre-

collapse or post-collapse? The size of the lesion, is it a small lesion or a big lesion? We'll show you some of that. The age of the patient. While most of these patients are in their 30s and 40s, some of these patients might be in their 50s and 60s. Therefore, a total hip replacement may be more appropriate than in a younger patient. What's the underlying disease? Unfortunately, many patients with osteonecrosis have other important diseases, such as lupus or kidney disease, severe asthma, pulmonary disease, which may have some life-limiting aspects to the basic disease process itself.

In this next slide, we're looking at a method of measuring the size of the lesion. This is called the Carable angle. We take the angle on the left, which is marked A, which encompasses the lesion. Then we take a lateral of the hip and that's B. We add that together and that gives us the Carable angle, which we can use to evaluate the size of the lesion. Lesions that are smaller than $180^{o}$ on the Carable angle, measuring the two, are considered to be relatively small lesions. Anything over $250^{o}$ is a large lesion.

In the next slide, we see a small lesion on the left, which is probably not going to progress and may never become symptomatic. On the right we see a large lesion which involves almost the entire femoral head. This head probably can't be saved, no matter what you're doing.

It's difficult to know exactly what the natural history is of osteonecrosis, simply because all the lesions aren't the same. In many of the studies that have been published, we really don't know the size of the lesion. We don't know where the patient started out. However, there have been a number of studies that have been published, 21 studies reported by my partner, Dr. Michael Mott, published in 1996, in which if no treatment was carried out, there was a success rate of only 22% and this was with only 2-4 year follow-up.

Now, as I mentioned earlier, the goal of the treatment for osteonecrosis would be to preserve the femoral head. With large lesions and with advanced lesions, it's already too late and we're looking at total hip replacement, resurfacing of the femoral head, a variety of other advanced surgical procedures. When the head is not yet collapsed, there are a variety of things that can be done to try and preserve it. Core decompression is quite a popular procedure. It has a success rate that's in the 60-70% range, but it's a small surgical procedure with a quick recovery and a low morbidity.

This is a patient who had a core decompression in 1975 on the left hip. You can see that this looks radiographically normal. In 1996, 21 years later, that patient still had his own femoral head, which functioned normally. On the opposite side, he had a more advanced osteonecrosis. He had a total hip replacement in 1975, a revision in 1983, a re-revision in 1992, and I believe another revision in 2002, so you can see that in those patients for whom core decompression works, it can be a very satisfying procedure.

MARC HUNGERFORD, M.D.

Okay, we're about to try the acetabular sizer.

DAVID HUNGERFORD, M.D.

The acetabulum has now been prepared and we're going to see how that trial fits.

MARC HUNGERFORD, M.D.

This is the trial. You can see we have a curved inserter to get down and around the corner. This is a little bit smaller than our actual cup will be. We're going to see if we can get this in. There we go.

Let's look at the fluoro image. That looks pretty good to me. What do you think, dad?

DAVID HUNGERFORD, M.D.

Yeah. That's one of the advantages of this approach; you really can control your acetabular position. We'll come back when they get ready to implant the prosthesis. Let's just take a look at some of the other treatments. This is an osteotomy for osteonecrosis. We tend not to do this very much anymore because of the impact that it has on the femur. It deforms the femur. You have this hardware that has to be taken out. When and if a total hip replacement has to be done, after this procedure it's a lot more difficult.

Another procedure which has been popularized is the free vascular fibular graft. In this slide we see a patient with osteonecrosis and the fibula in place and the follow-up film. I think this is a very valuable technique for certain cases. The problem, I think, with free fibular graft is that it does take the patient's fibula and there's about a 20% incidence of symptoms that the patient experiences in the area where the bone graft is taken. Therefore, I think one has to be very careful and very selective. The lesion can't be too big. It's probably better in younger patients, under the age of 30, for whom other treatments are ineffective. There are a variety of bone graft techniques in which grafts are put up either through the femoral neck or through the proximal femur to try and support the collapsing segment. I think this is an area where great progress will be made in the future as we have better and better materials to work with. We have artificial grafting material. We'll cover that in a moment.

There is a trap door procedure, which is illustrated here. Again, there aren't many patients who are candidates for this, but this shows a series of patients, starting on the left. In the middle upper picture, you can see dead bone, which is exposed in the cartilage cap and in the upper right you can see the strut grafts that have been positioned. In the lower left, the cartilage cap has been put back on the femur and then the lower middle shows the hip relocated and the graft in place. On the right, the femoral head has been recovered from a patient who had this procedure several years afterward. The graft did incorporate, but the patient continued to have pain and had a total hip replacement. The success rate of this procedure is about 70%.

MARC HUNGERFORD, M.D.

We're ready to do the implantation.

DAVID HUNGERFORD, M.D.

Can you show us the acetabulum, Marc?

MARC HUNGERFORD, M.D.

Yes, just a second. I don't know if you can see that there, but that is the acetabulum.

DAVID HUNGERFORD, M.D.

There's a good exposure. You can see the bleeding bone. That's really what you want to see when you're ready to implant the cup. Want to show them the cup?

MARC HUNGERFORD, M.D.

Yup. This is the socket. It has a porous in-growth surface here. It has a couple of holes that we can put screws through and then the back is where we snap the plastic into. Then you can see this Dr. Seuss-designed retractor here to place it in and we're ready to go. You can see the size of the incision is just about the size of the cup. This is a significantly larger femoral head than normal. That looks pretty good to me.

DAVID HUNGERFORD, M.D.

Looks good. Okay, he's going to now place in a locking screw, kind of a belt and suspenders because this is a pretty fit and then put in the plastic liner. While he's doing that, we'll answer some of the questions that have come in over the web, of people who are actually watching live. The first question is what's the biggest advantage of the MIS total hip replacement surgery as compared to the more traditional type and is the recovery period any shorter or easier? MIS has enjoyed enormous popularity and it has captured the public interest. I think that the correct place for MIS surgery is not yet fully established. It clearly is not indicated for everybody. There are patients with too much deformity. There are patients who are too heavy. There are patients with shortened femoral necks, deformed femurs, require acetabular bone graft. It's not indicated for revision total joint replacement. Although there is certainly the expectation that smaller incisions will lead to quicker recovery, the recovery from a standard total hip replacement is actually pretty quick. I think that many people who are practicing minimally invasive surgery experience that patients have less pain and less blood loss, but if the exposure is not adequate, and I think you can see in this particular case so far we have had a very good view of the socket. If you cannot view it to the degree that's been demonstrated today, you run the risk of actually damaging a bone in which there's not a lot of excess to be reamed away, so I think the answer to the question is that the proper place of MIS therapy in the total spectrum of hip surgery awaits longer experience and period of time. It's an exciting new development. Where its role will be in the future among the 200,000 patients who have total hip replacement is yet to be determined.

MARC HUNGERFORD, M.D.

What I tell my patients is the most important thing for hip replacement surgery is that you have a pain-free and durable joint. Those are the long-term issues and I think people think that's really a given, but it's only a given if the prosthesis is put in right and if you have good quality components. Then I think most people do have pain-free joints that are durable for a long period of time. However, even with the best components, if the prosthesis isn't put in right or if there's an intraoperative complication, like a fracture, or a postoperative complication, like a dislocation, and you have to have a reoperation for some reason, then it doesn't really matter very much whether the recovery took two weeks or three months if the patient's still not happy.

DAVID HUNGERFORD, M.D.

Another patient has written in and asked about osteonecrosis of the knee. The patient has had core decompression of the knee, has large areas of dead bone. There doesn't seem to be any hope of the bone coming back, according to the MRI. The patient wants to know what the chances are of eventually going to knee replacement. The natural history of osteonecrosis of the knee is actually quite different from osteonecrosis of the hip. It tends to progress much more slowly. Progression is not nearly as certain as it is with the hip. Many patients can last for a long period of time, so therefore, the decision to proceed to a total knee replacement is based purely on the patient's symptoms. Total knee replacement can be very successful in patients with osteonecrosis, in spite of the fact that large areas of bone may be involved.

While we're finishing up on this acetabulum, let's just take a look at a couple of the other things we can do, other than total hip replacement. This is a hemi-resurfacing, in which just the femoral head is resurfaced and not the socket. This is applicable for patients probably in their 30s, in whom the socket is not yet involved. It's intended to buy time for the patient so they can be maybe 10 or 15 years down the line before they have a hip replacement and hopefully that will be a time when the hip replacement will last for the 40 or 50 years that they have to live.

MARC HUNGERFORD, M.D.

You can see on the fluoro, the cup is in. There's a single screw fixing it into place as additional fixation. Now we're going to put the plastic liner in. This is an ultra high molecular weight polyethylene, so it looks like plain plastic, but it's very high tech plastic and it wears very, very slowly, so a part like this can last 20 years or longer. It is still a mechanical device and I frequently get questions about how long will my hip replacement last. The answer to that depends on your weight, your activity, and your age, so younger, more healthy patients tend to wear out their hip replacements more quickly than do older, more sedentary patients. That is one of the additional problems that patients with avascular necrosis face because they are young and they're relatively healthy, so a lot of them are quite active. They can have problems later on in life, after

they've had a successful total hip replacement where the joint wears out. We like to use as durable a material as we can find and this is one of them. It's not the only one, but it is one of them.

This has a locking mechanism whereby it snaps into the cup. We have to make sure that it's all the way locked in. Okay, so we're done with our acetabulum. Now we can turn our attention to the femur.

Okay, in case we run out of time, I just want to illustrate how this is going to go. The femur doesn't take as long as the acetabulum. Basically what we do is we're going to cross the leg like so and we're going to make a very small incision here, less than an inch long. We're going to find the corresponding area on the femur and we're going to just put the broaches through the skin, into the bone, and find the right level. So let's go ahead and start with that.

DAVID HUNGERFORD, M.D.

One of the write-in questions is why a 59 mm acetabular component for a 55 mm joint? Well, you've got 1 mm or so of articular cartilage all the way around, so that makes it 57 mm, just to take the articular cartilage off, and then you want to take 1 mm or so of bone so that you've got a good bleeding surface of bone and that takes you to the 59, so you're not putting in...if you were just resurfacing the femoral head and putting it back in the native socket, then you would want to use a prosthesis that is exactly the same size as the head you were replacing, but when you're putting a liner in the acetabulum, it needs to be in contact with bleeding bone, so you need to take about 2 mm all the way around in order to accomplish that and that is what we've done.

I made a comment about life-limiting diseases associated with avascular necrosis and that impacting. One viewer was concerned that they had COPD and wanted to know what this meant. COPD is often treated by cortisone. Cortisone can affect the development of osteonecrosis. COPD is a chronic lung condition, obstructive lung condition, that can be of a wide variety of severities. Severe COPD definitely has certainly the possibility of limiting life expectancy, but COPD in and of itself doesn't necessarily have that. The fact that it is associated or not associated with osteonecrosis does not affect longevity. Some patients with severe kidney disease or severe lupus, it may affect their life expectancy, so if you have a 40-year-old with severe life-limiting disease, that would affect your treatment.

We're now looking at the size of the posterior incision to gain access to the femur. You can see that this is just big enough to allow the instruments. We're running close to the end of this webcast, but we've gotten word from the producers that we can continue. While they're getting femur exposure, I want to go to some things for the future. On this slide, this is an experimental condition in which a defect has been created in the bone. Under normal circumstances, this defect would not heal spontaneously. On the right, there has been injected into this defect a material which stimulates the new formation of bone. You can see that the bone is completely healed. This is material called OP1. It

currently is not available for use in osteonecrosis, but this and other things like it will become available in the future and they have the potential to allow us to regenerate the dead bone in the femoral head and elsewhere and I think this offers some hope for innovative new treatments in the future.

Another patient asks, the MRI showed that only about 1/8 of the femoral head is deteriorated. What can that patient expect? As I said earlier, the size of the lesion is very important. If the lesion is very large, then it is likely that it will collapse and anything that can be done has a much lower success rate. If the lesion is very small and the patient doesn't have any symptoms, it might not need to be treated at all. If the patient has symptoms and the lesion is small, then things like core decompression with bone grafting or some of the other conservative measures, just a variety of bone grafting techniques have a very good chance of being successful. We're going to come back to the surgery now.

MARC HUNGERFORD, M.D.

We have the small wrench in the capsule. The capsule is the lining of the joint and I made a little slit in it, not even a cut or anything, just a little slit. This is one of the reamers that we're going to use to prepare the place for our stent. The fluoro shot shows me that I'm in the right place.

This patient had a previous fixation of a fracture, so he's got an area of hard bone kind of in the middle of his femoral canal, here it shouldn't really be, but hopefully that won't cause too big of a problem. Okay, we're just about there. I've made sure that we haven't come anterior. Now, you may see a little bit more bleeding at this point and that's because we've put something into the femoral canal. The femoral canal has a lot of bone marrow in it and bone marrow is what makes blood, so once we start to stick things into that femoral canal, it definitely starts to bleed a little bit more.

Okay, so that's the first one. Now we've got a series of broaches like that, if you want to make some more comments about AVN, in general.

DAVID HUNGERFORD, M.D.

That shows the broaching and how it's done. We'll break away from that for a moment, as he continues to broach to the final size and go to some questions that came in from our viewers. This patient reports that they had a core decompression of the left shoulder in February of this year, but that it's not healing like they had hoped. The patient is steroid-dependent for severe asthma. The question is will it ever heal? The core decompression probably does not lead the bone to heal. It in some ways stabilizes the bone. It relieves the pressure and relieves the pain. It probably does contribute to stabilization, as whenever you create a wound, you get some healing process. Core decompression of the shoulder has probably been more successful of any of the other joints because the shoulder is not basically a weight-bearing joint. However, if it's unsuccessful, then the

next thing that needs to be done is either a humeral head replacement that's just the ball part of the shoulder or a total shoulder replacement.

This patient also has symptoms in other joints, which is actually quite common with steroid-associated osteonecrosis. Any joints that are symptomatic should clearly be investigated with x-rays and probably an MRI to see whether osteonecrosis involves those joints as well.

There are several terms for osteonecrosis. I personally prefer the term osteonecrosis, which is very simple. It's made up of two words: osteo, which means bone, and necrosis, which means death. The other term you may hear is avascular necrosis, which is death from the lack of a blood supply, but there are other possible reasons for bone death, such as irradiation for patients who have had tumors. Ischemic necrosis is another term, which means that the blood supply is diminished, but I think the easiest and the best term is osteonecrosis.

A patient writes in that they've recently been diagnosed with osteonecrosis. They're having trouble walking and standing. They have their first appointment with the orthopedic surgeon next week. What can they expect? One of the things that I've tried to emphasize is that osteonecrosis is really a very broad spectrum in its presentation. It affects different joints. Its effect is different in size. It's different stages, whether it's collapsed or not collapsed. What you can expect is for the orthopedic surgeon to define for you and to relate to you the size of the lesion and what the treatment options are. That's going to be dependent upon how big it is, how far advanced it is, so you're really not going to know what to expect until you have those parameters better defined.

This is a very good question. Is osteopenia or osteoporosis related in any way to avascular necrosis or osteonecrosis? Could it be some kind of precursor to osteonecrosis? It's very interesting. One of the things that we're looking at and intend to look at more intently in the future is the fact that steroids cause osteoporosis and also osteonecrosis, but usually, in fact almost never, in the same patient. The patient who gets osteonecrosis does not get osteoporosis and vice versa, so you have the same drug, you have the same bone, and you have two different responses. We think there may be some answers in that, as we understand what steroids do to bone, how bone cells and blood supply to bone responds to steroids, but the answer is that there is no cause and effect relationship between osteoporosis and osteonecrosis.

Here's a patient who writes in that they had a total knee replacement in April and in August they will have a right total knee replacement done. They're 51 years old. They wanted to know if they'll walk normally after rehab and PT. These knee replacements were done for osteonecrosis. Patients after a total knee replacement can actually function almost completely normally. I have patients who walk several miles a day for exercise on a regular basis. However, a total knee replacement is not a normal knee. We would not anticipate that a patient with a total knee replacement would be able to run, play contact sports. Some patients are able to play a little doubles tennis, but in terms of the activities of daily living, going up and down stairs, walking however far you want, the total knee

replacements done today provide that in the vast majority of patients very well, so I think you can expect a return to pretty much a normal life.

One patient wanted to know if using crutches would help buy time. As we mentioned earlier, it's the combination of dead bone and the loading of bone that causes the bone to collapse, so inactivity and using of crutches can definitely put off collapse of the joint and the attendant pain. However, while that might be a temporary solution, there aren't many people in their 30s and 40s who are interested or willing to use crutches for a prolonged period of time to put off a total joint replacement.

Let's come back to the surgery and take a look at where we are in the femoral preparation. Now you can see that we're getting down to a size that really fills the femoral canal pretty well. The key is, when he hits it and it doesn't go any further, that's stable. That's looking like it's locking in there pretty well. What size is this, Marc?

MARC HUNGERFORD, M.D.

This is 11.5.

DAVID HUNGERFORD, M.D.

That's what you templated for, isn't it?

MARC HUNGERFORD, M.D.

I think we templated a 13.5. 12.5.

DAVID HUNGERFORD, M.D.

So he has a 12.5 in and he templated for a 12.5, so that's looking pretty good.

A patient writes in with an interesting question. Patient has osteonecrosis of both knees and has had evaluation of the hips and the hips were clear. The cause of the osteonecrosis is steroids and the patient has been off steroids now for some time. The question is when can he be considered safe as far as getting osteonecrosis of the hip? In our experience, if the patient does not have to go back on steroids and there's no evidence of osteonecrosis in the hips now, then the patient is no longer at risk for getting osteonecrosis of the hips.

MARC HUNGERFORD, M.D.

Okay, so we're going to implant our prosthesis now. The prosthesis is a fair bit bigger than the broach because it has a neck that you can put a ball on for the ball and socket joint. Fitting that in can present a bit of a challenge.

Okay, this is the prosthesis. It's made out of titanium. It has a surface here that's designed for the bone to grow onto and then this is the business end here that we're going to put a ball on once we get it in.

I may have to extend my incision because men generally have tougher skin than women do, so sometimes you have to make a little bit bigger incision because you can't just push it out of the way. We'll make our incision just a tiny bit bigger. This is a plastic film that we put on the skin. That's not skin. I know it looks a little funny. It doesn't take much at this point, usually. Okay, we're good to go.

Okay, I'm going to check it for rotational stability. It's stable. So the anteversion is between 0 and 5, which is what I like. Okay, so the last job we have to do is the femur, which we've put in kind of from behind with this little excision. We've put the femur in from behind and now we have to bring it out to the front of the socket.

DAVID HUNGERFORD, M.D.

We've got a question about full resurfacing versus total hip replacement for someone under the age of 50. The full resurface is one of the options for hopefully a long-lasting joint replacement. There are really four considerations, I think, right now and there's a lot of uncertainty and not a small amount of hype. There's ceramic on ceramic for a long-lasting hip, metal on metal for a long-lasting hip, metal on highly cross-liked polyethylene, as has been used in this case, and then the full resurfacing. The full resurfacing has the advantage in that it's a big head and therefore the dislocation out of the socket is going to be very difficult. It's metal on metal, has a large surface area, and it's fairly difficult to get in and has some complications that total joint replacements don't have and that is the potential for fracture of the femoral neck. There are some people in the country who are carrying this out. At this particular point, we really don't know whether this is a better solution or not. If any one of the others turns out to be a satisfactory, long-lasting total hip replacement, which we are hopeful but we don't know, then I think that surface replacement will have proven unnecessary. On the other hand, surface replacement does offer an option to simply convert a failed surface replacement into a total joint replacement and is clearly easier than revising a total joint replacement to a revision total joint replacement. So the answer to the question is probably 5 or maybe 10 years away. Surface replacements are being done. We don't know yet whether they're better or not. They have theoretical advantages. They have some theoretical disadvantages in that they have other ways in which they can fail. So we're going to have to come back in about 10 years to answer this particular question.

There's a question about viewing this webcast at a later date. Yes, this webcast in its entirety will be archived at www.goodsam-md.org for one year. It can reviewed, any part of it can be reviewed or all of it can be reviewed. For the coming week, those of us who are involved in the webcast will be answering email questions that have come in that we either didn't have time to answer on air or appropriate email questions that come in for the next week. We will divide this up and get out answers. Those questions and the answers will be archived also on the website. I also want to point out that on your entry

screen when you came into this webcast, there was a link to the Johns Hopkins Center for Osteonecrosis Research and Education website, which is www.osteonecrosis.org. We have a lot of information for both patients and physicians. We have a lot of common questions about osteonecrosis. We've got a brochure that's available as an online brochure for education about osteonecrosis.

MARC HUNGERFORD, M.D.

Almost there. This can be a challenge sometimes.

DAVID HUNGERFORD, M.D.

We have a patient who has asked a question about a cortisone shot. The patient needs to have a total hip replacement, but the husband is having some medical problems and she needs to be functional and wants to know if a cortisone shot in the hip would be helpful. This is a question that you're going to have to ask your doctor. We do sometimes do cortisone shots in the hip. We do them in the operating room under fluoroscopic control. Under certain circumstances, they can be very helpful. In your particular case, I couldn't say yes or no, but it certainly is a possibility.

MARC HUNGERFORD, M.D.

I'd really like to be able to show the end of this, but we have to be able to get the stem through the capsule in the back and it can be a challenge. This gentleman has a very thick capsule.

DAVID HUNGERFORD, M.D.

Marc, we have a question for you. How often do you see increased ectopic or heterotopic ossification with this two-incision approach?

MARC HUNGERFORD, M.D.

One of the nice things about this approach is you really, the anterior interval, you don't cut any muscles or tendons at all. On the posterior side, the only thing we cut is we actually spread the fibers of the gluteus maximus apart enough to put the broach in and get the trunion through. I guess you could say I'm probably cutting a little bit of muscle here to get the trunion or the business end of the stem through, but really very, very little muscle damage, so one of the benefits of this is that we don't see very much heterotopic ossification with this approach. That's one of the positives.

DAVID HUNGERFORD, M.D.

So you think it's less.

MARC HUNGERFORD, M.D.

Yes, quite a bit less.

DAVID HUNGERFORD, M.D.

Heterotopic ossification is often associated with trauma to the soft tissues. To the extent that this minimizes the trauma to the soft tissue, one would think that it ought to minimize heterotopic ossification.

This patient asked I have osteonecrosis of both hips from Prednisone and maybe alcohol. What are the chances it will develop in other joints with cessation, without cessation? This is a very difficult question to answer. I'm not aware of any studies that have been done particularly to segregate this out. There was a paper on the results of core decompression and they segregated patients who continued on steroids after the core decompression, compared to patients who did not need to continue after core decompression, and the results were pretty much the same. Those who continued on Prednisone didn't have quite as good results, but the difference wasn't statistically significant.

The last step in this hip replacement is getting the leg length right. Part of that is templating, getting the components in the right position, and part of it is selecting the right head length. This is where we are now.

MARC HUNGERFORD, M.D.

First I'd like to show you the stem is now in. Maybe you can get a picture of that here, so there you can see it. You can barely see it but that's because we don't have much of an incision.

DAVID HUNGERFORD, M.D.

This is a temporary head that's going to be put on the trunion.

MARC HUNGERFORD, M.D.

That was easy. Okay, let's bring the fluoro in. It looks pretty darn good. Okay, I think we'll stop right there. We can draw back and see the size of our two incisions. This one is a little bit larger than normal. It's about the size of my finger. So is this one, about half the size of my finger, but they're still pretty small. You can see where we've finished up. We've put the hip in through these two incisions, the socket in through the anterior and the femur in through the posterior, and the result looks like we have the appropriate leg length and all set.

Thanks for joining us.

DAVID HUNGERFORD, M.D.

Well, we'd certainly like to thank you for joining us for this exciting transmission from the Good Samaritan Hospital. This hospital houses the Johns Hopkins Division for Orthopedics at the Good Samaritan Hospital and we'd like to thank you for joining us and remind you that we have a website, www.osteonecrosis.org, and that this presentation will be archived for one year. Thank you very much.

NARRATOR

Thank you for watching the live webcast of a minimally invasive hip replacement surgery for osteonecrosis from Good Samaritan Hospital in Baltimore, MD. For more information, to make a referral, or make an appointment, please click the buttons on the player window or launch page.