**MAXWELL LANGFITT, MD:** This talk is several-fold. It's anterior hips first. Then we'll talk about partial knee replacements, and robotics a little bit in orthopedic joint surgery. So the objectives of this first part of this talk is just to talk about what an anterior approach is and how it differs from a posterior approach. Why do we do it, when do we do it, and who do we perform it on, and how do we do it?

So just a little about myself first. So I grew up in Pittsburgh, Pennsylvania. I moved to Winston-Salem to go to college at Wake Forest. And I've pretty much been here ever since. So I stayed here for college, med school. I did residency here, and spent a year in Boston for a total joint fellowship, and then came back here last year.

So just to kind of reiterate what Dr. Shields is talking about, about hip anatomy, just before we get into the anterior approach talks. So the hip, everyone knows, is a ball and socket joint. The ball is the femoral head. That's the top of the femur. The socket is the acetabulum, the cup part of the pelvis. There are soft tissue structures around the hip. The labrum is a soft tissue structure, and that helps to increase the surface area, and helps with stability, as well.

So what are some common causes of hip pain? Arthritis is one of the most common causes of hip pain. It affects 43 million Americans, and the incidence is increasing as the population ages and becomes more active. So arthritis is several-fold. It's genetics, it's wear and tear, it's aging, it's diet and exercise related. And if there was any trauma or sports injuries in the patient's younger days, then that certainly has a role in it, as well.

Labral tears can cause hip pain. Avascular necrosis, which is decrease of blood supply to the hip, that can certainly be a cause of hip pain and then ultimately collapse of the femoral head. Fractures and congenital abnormalities, so things we're born with, or again, an injury, a trauma. And the low back pain can actually manifest itself as hip pain, too.

So just some x-rays to show what an arthritic hip looks like. So the x-ray on the left is a normal, healthy hip joint. You can see the joint space that's maintained between the ball and the socket. Comparing that to the right, you can see how there's really no joint space left there at all. There are also some bone spurs that have developed, both around the femoral head and the acetabulum, and then some cysts in the bones. Those are all signs of arthritis-- loss of the joint space, cartilage loss, development of bone spurs, cysts in the bone. Those are all radiographic findings we look for, both with hip in the arthritis and then the arthritis that affects any joint.

So treatment options, we always start with non-surgical. We're surgeons. We want to operate. But we want to do what's best for the patient, too. We don't want to just jump to surgery if we can help them prior to surgical intervention. So standard non-operative treatment, conservative treatments are prevention.

So maintaining a healthy diet, healthy weight decreases pain in the joints. It also prolongs the longevity of a joint. Maintaining a diet that's high in antioxidants, low in added sugars and carbohydrates helps with weight loss. Exercising-- a lot of patients ask about exercise and what can I do? Is it OK to exercise when my hip and my knees hurt? And certainly, we highly recommend it. It's important to keep the joints strong-- the muscles strong and the joints mobile. And one of the worst things to do is to become inactive, and then joints get stiff, and it becomes more painful, and it's kind of a downward spiral after that.

Medications-- over-the-counter medications, we always recommend those, as far as Tylenol and anti-inflammatories like ibuprofen, Motrin, and Aleve, Celebrex. Injections are useful both therapeutically and diagnostically. A lot of times the patients come in with a hip pain that's not as straightforward. There's some degree of low back pain or some trochanteric bursitis, and they have an injection in their hip, and it alleviates their pain. That's a pretty good sign that their pain's coming from some interarticular source, whether it's arthritis, or avascular necrosis, or a labral tear. And if they have the injection and it doesn't give them much relief, then total hip's certainly not the recommended treatment for them.

Bracing can be useful, especially knees. Physical therapy-- all the physical therapists in our system and the ones we've worked with are fantastic, and we appreciate their help. And a lot of patients come back and say that, well, just having physical therapy was really beneficial. And then assistive devices, so aligning the joint with a cane, a walker, can be useful for patients, too.

And only after those have failed is surgical treatment recommended. Arthroscopy can be useful treatment in certain instances-- not arthritis, but for certain soft-tissue injuries like meniscus tears, labral tears, it can be useful. And then ultimately, joint placement, just to take out the damaged bone, the bone spurs, and the arthritis.

So just to review again what Dr. Shields had mentioned, that what we do during a hip replacement is remove the damaged bone. We take out the ball, take out the-- ream in to the acetabulum, take out the damaged bone, and ream into good, bleeding, healthy bone, remove the bone spurs.

So what we're doing is putting in this metal stem. It's a titanium cementless stems that we typically use. It's a titanium cup. A polyethylene liner is typically used, but the other options, as Dr. Shields mentioned, are a ceramic liner or a metal liner. Both have kind of fallen out of favor. And then the head ball can either be a cobalt chrome is a metal alloy. Ceramic or another special metal called Oxinium is commonly used, as well.

So this is just another graphic depiction of that. So you see the x-ray on the right with the new hip replacement. So this kind of shows what the components themselves look like. So the acetabular shell and the femoral stem, typically titanium. The polyethylene insert, femoral head, it's oftentimes ceramic or Oxinium now. The reason we're doing that these days as opposed to the cobalt chrome metal head which was used historically is because you hear a lot about metal on metal. And metal on metal historically is the metal head on the metal liner. And that's why we don't use the metal liner anymore.

But there are a lot of studies, especially now, talking about metal debris that can actually be created from the metal head on the metal neck of the stem. So that can create metal debris even though it's not technically a metal on metal hip. So that's oftentimes why, especially in younger patients, we use the ceramic ball or that Oxinium, which is a different type of metal.

All right. So talking about anterior and posterior approaches. So as Dr. Shields mentioned, both are great approaches. They both accomplish the same goal. We're taking the arthritis out. We're putting in new implants. And overall, they're pretty much the same implants. It's just a different way of doing it.

So hip replacements are listed as one of the most effective and successful surgeries in medicine. So if a posterior hip replacement is so great, why even change it? Why even try to do an anterior approach? So there's been a lot of press about anterior approaches from word of mouth, and in news and literature, and patients asking about it. And a lot of people are under the impression this is a brand-new approach.

This is actually something that's been around for a long time. It was initially used in trauma procedures, and it's kind of been adapted to hip replacements. So the first one was done in 1947 by Robert Judet in Paris. And the approach used to be a much longer incision. That's what's used for trauma surgery. But, too, it's been adapted to do hip replacements, and this incision has been made much smaller. It's more tissue sparing and it requires fewer releases and less post-operative precautions and care afterwards, too.

So the current technique we use is kind of a modification of that trauma incision. This uses an anterior incision. The benefit of this is that it uses a true internervous and intermuscular interval, so it's actually going between the muscles innervated by the femoral nerve and the superior gluteal nerve. The incision is from the ASIS, which is the anterior pelvis, about 8 to 10 centimeters distally towards the lateral aspect of the patella.

So it's a pretty small incision. And because it is using an internervous or intermuscular interval, that's one of the reasons people think that it's more tissue sparing and it's also-- it creates less pain afterwards, too. So there are less muscle and tendon cuts from the pelvis or the femur. But again, overall it's the same implant. It's the same procedure, getting to the same goal. It's just a different way of doing it.

So why do we do this? What are the benefits of an anterior approach over a posterior approach? So aside from being this intermuscular internervous plane, it's muscle sparing in that it preserves the hip deltoid. So the muscles around the hip are similar in a way to the rotator cuff muscles in that there are muscles and tendons that come around the ball and socket joint and attach on the lateral aspect of the humerus for the rotator cuff and the femur for the hip. So those are the tensor fasciae latae, the abductors, and the IT band. And those come together to form the IT band.

Sometimes patients can have pain if there is disruption of those muscles or disruption of the IT band. They can have trochanteric bursitis or a lot of lateral hip pain. And this anterior approach preserves that because you're actually coming in front of where those muscles are. And from that also there is less muscle damage.

The other benefit is that the hip joint is actually more superficial anteriorly. So sometimes patients who may be a little bit larger, if you're doing posterior approach where they're on their side, a lot of the soft tissue in their buttock is right in the way and you have to get it through centimeters or inches of soft tissue to actually get to the hip joint as opposed to an anterior hip. When you have them supine, they're lying on their back, that tissue kind of falls away and their hip joint is actually pretty superficial. So that makes it a little bit more accessible anteriorly. You actually get very good acetabular exposure with this approach. Again, the hip joint is pretty superficial, so after you're able to cut the head and the neck and remove that, the acetabulum is kind of looking right at you.

The other benefit of this is doing it supine on this Hana table that we use allows you to use x-ray pretty easily. So we have CRM in the operating room and we're able to look at the positioning of the implants in real time. So not only we're using our interoperative guides and techniques, and our preoperative templating with computer software, but we're actually using x-ray, too, to make sure that these implants are in a good position and we're satisfied before we leave the operating room.

And then it's also-- in the rare patient who does have bilateral hips done, this does make it a little bit easier to do bilateral hips because they're in the same position. We don't have to flip them to the other side, and then worry about the side we just did, and them lying on that side.

So as far as why to do this for patients, what's the benefit to patients? So all the preceding are obviously benefiting patients. But there has been shown to be more rapid recovery with an anterior approach. There have been several studies that showed that there is a decreased length of stay. Other studies show it's about half a day, which doesn't sound like a whole lot, but if it's additive, and for hospital costs, too, that does make a difference. And certainly, patients don't want to be in the hospital any longer than they have to be. No one wants to be there. Everyone wants to get home and spend time with their families, and their sleep in their own bed instead of sleeping in the hospital bed and getting woken up all night.

There's also more rapid improvement in function and strength. Again, we're not truly disclocating the hip like we do in a posterior approach, nor are incising the IT band or cutting through the muscles around the hip per se. There's also a decreased risk of leg length discrepancy. So again, having CRM x-ray in the operating room, we're able to assess the final construct that we have. We compare the upper leg to the contralateral leg to make sure that the leg lengths appear appropriate. And we don't typically use hip precautions for this approach, either. It's an inherently stable approach because we're not disrupting any of the posterior structures.

So we'll kind of go stepwise how we do this procedure. This is just an overall picture of what the hip looks like from an anterior approach. And that's a larger incision than we typically do. But you can see the muscles that are separated, and you actually see down to the hip joint, too.

So we use this specialized table, this Hana table. This is a picture of what that looks like. So a patient's lying supine. They have their legs strapped into these ski boots and that allows us to manipulate the leg both in rotation and extension. And the incision is about 8 to 10 centimeters beginning just distal and just lateral to the ASIS, so the bony prominence on the anterior pelvis, and then going distally towards the lateral patella. Not that far, not all the way down the leg, but just in that direction.

So after we make that incision, the soft tissue layers are bluntly dissected down to the fascia. So the tissue layers that make up these internervous or intermuscular intervals, the first layer is the tensor fasciae latae and the sartorius. So again, this is an internervous plane. The tensor fasciae latae is innervated by the superior gluteal nerve. The sartorius is innervated by the femoral nerve. So we're bluntly dissecting between those two planes.

The next plane that we get to is between the rectus femoris and abductors again. The abductors are innervated by the superior gluteal nerve. The rectus femoris is innervated by the femoral nerve. So we're also bluntly dissecting between those two layers, too. And once we get there, we're able to identify the hip capsule. So the hip is not that deep anteriorly. So once we find these layers and are able to dissect between them, we get down to the hip capsule relatively quickly.

So we retract the sartorius and the rectus femoris medially, and then the abductors, the vastus lateralis laterally. One of the things that is one of the downsides of this approach that we'll talk about is the nerve that you can see in the top right picture is the lateral femoral cutaneous nerve. It's right in the field. And what that innervates is-- it's all sensory. It's not motor at all-- innervates the lateral aspect of the thigh.

So a lot of times, patients after an anterior approach complain of some numbness on their lateral thigh. And that's due to this nerve. The incidence is about 15% to 20% that this nerve either gets a neuropraxia, so a stretch injury. But sometimes it can actually be cut, too. And that is one of the downsides of this approach. But again, it's a sensory nerve. It's not a motor nerve at all.

So one of the other neurovascular structures that's in the field when we're doing this procedure is the lateral femoral circumflex vessels. So the main blood supply to the hip as an adult is the medial femoral circumflex. So that's something we see during a posterior approach. The lateral femoral circumflex is during the procedure in the anterior approach, and those are vessels that we see when we're bluntly dissecting. And we find those, we cauterize those to prevent further bleeding.

So after we get through that tissue plane, then we reach the rectus femoris, as we talked about, and mobilize that immediately. And then we see the hip capsule and we make our capsulotomy. So this is just a video that kind of depicts what we discussed.

So this is-- let me pause it for a second. So you can see that the abductors are at the bottom of the screen retracted by that-- it's a covert retractor, as we call it. And it's over the superior neck, so the top of the femoral neck. And the femoral head is covered by the soft tissue structure that's immediately-- that's kind of beige looking.

This other retractor that's at the top of the field, that's over the inferior neck. So the patient's head is to the right of the screen. Their feet are to the left of the screen. So the abductors, the tensor fasciae latae are this muscle group here. This is the IT band here. The sartorius is this muscle here, and the rectus femoris is here. So we're actually retracting the rectus and the sartorius medially and the abductors laterally. And again, this gives us a really good view of the femoral head and the neck right there. So the next thing we do is make our capsulotomy.

So that's a knife coming into cut the capsule that's overlying the hip. And the capsule is what keeps all the joint fluid within the joint space. And then we put sutures around that, just to retract it out of the way further.

So after we do that, then we're looking at the femoral head and the femoral neck. And the next step, just like the posterior approach, is to remove that damaged bone. So after we get exposure, then we make our femoral head and neck cut, again from preoperative templating. And we also use x-ray in the operating room to make sure that that neck cut is exactly where we want it to be. Because we want to restore a patient's natural hip center the best we can, restore the offset the best we can, the normal biomechanics of the hip the best we can. So after that femoral head is removed, then the excess soft tissue like the labrum and the other soft tissue structures are removed from inside the hip joint.

So this video is going to show that sometimes what we do is actually dislocate the hip first by external rotation from that specialized table-- that Hana table. And then we internally rotate it to get it back into joint. That helps us mobilize the tissues a little bit further. And then we remove the head and the neck. So this is just a video of the hip being dislocated with external rotation. That's just what we call a corkscrew. That goes into the femoral head and it helps us actually remove it after we've made the bone cuts.

So that's the hip being relocated. And then we're going to come in here with the saw and then, just like a posterior approach, remove the damaged head and neck.

After that, the next step is to address the acetabulum. So again, with this approach we get very good exposure of the acetabulum. We get a really good look at the socket of the hip. So you can see on the top right picture that the re tractors are in very similar positions. The femur is retracted out of the way inferiorly. And we come in with the reamers and remove the damaged cartilage and the bone to get to good, bleeding bone, and then have this press fit for the acetabular component-- that titanium shell.

And you can see this picture on the bottom left, that this is actually a CRM shot, so we're able to see exactly where we're putting the implant, the exact angles we want it. So the inclination and the version, which is kind of the rotation of it front to back, we see that, as well. And this is the video showing that, too.

So good acetabular exposure. We'll take out the labrum and the soft tissue, and then come in with the reamer. And then ream into the damaged bone to get the appropriate fit for the patient through this acetabular implant. A lot of times we do use screws. This is a good press fit, but screws act as a backup just to help to hold that acetabular shell in place until the bone grows into it, which holds it in place for long term. So it's a backup plan. And patients will never know the screws are there because they're all inside the bone. They'll never feel them. It's just an additional support. And then we put the polyethylene liner in after we put screws in.

All right. So the next step is to address the femur. So we've placed the cup in the polyethylene liner. The next step's the femur. So this is one of the downsides of doing the anterior approach. This part of the procedure is very difficult to have mobilization of the femur.

So what we'd actually do is there's a-- it's a hook that actually lifts underneath the femur and hooks into this Hana table that we use-- again, on the top right. And that helps to elevate the femur further. There are soft tissue releases that are done to release some of the capsule from the posterior aspect and the lateral aspect of the femur. And that helps to bring the femur out further and elevate it higher so we're able to put that broach in to get the appropriate size fit for the femoral stem, just like a posterior approach. The leg is externally rotated. It's adducted and hyperextended to help us visualize the femur.

Occasionally we do releases of soft tissue structures in addition to the joint capsule. We do release the piriformis occasionally and the obturator internus tendons if indicated. And then after that, then we broach the appropriate side. So the picture here you can see, that's actually what we call the calcar of the femur. So that's the remaining proximal femur after the head and neck have been removed.

The picture on the top right, so that's after we broach. We have our trial implant in. There's the trial neck that goes on and the trial ball. And the picture on the bottom right is after we are then able to internally rotate the leg and pull traction, and get the hip relocated. So that's with the new bone socket joint.

And the bottom left here is one of the great benefits of this approach, again bringing in CRM fluoroscopy. We can have an x-ray and we can actually see what the final construct will look like. So we can assess our leg lengths, assess the offset, which is how far off to the side the hip center comes.

And this is a video that just depicts that. So external rotational of the leg. We put this femoral lift in, which helps us elevate the femur and bring it out so we're actually able to access the bone before we begin broaching. This is a release of the capsule that helps to mobilize the femur further.

And then we begin broaching for this implant in similar implants to a posterior approach. And once we like our size, then put the trial head in to reduce the hip to make sure that we like it.

So afterwards, how do we close it? So we close the joint capsule and we close the fascial layer, and then we just close the skin. It's a pretty quick closure because there are not a whole lot of layers to close with this approach. It's one of the benefits.

So the sutures that we use are all absorbable. They're all underneath the skin. We use a top dermabond layer to aid in healing, as well, and prevent drainage from the wound, and an impermeable Aquacel dressing just like we do for all hips and knees, that stays on for seven days.

So anterior hips do sound pretty good. There are no patient restrictions. Patients do pretty well. They do recover pretty well for the most part. But you know, it's not all rainbows and unicorns. There are certainly downsides. So what's the catch to doing the anterior approach?

So not every patient's a candidate. Patients who are larger patients, both with some deformity of their femoral head, or neck, or their pelvis. Patients who have a larger pannus-- the downside of that is that the pannus could actually drape over the wound since it is such a superficial and proximal wound. That can cause healing issues and infection.

It's also a very challenging surgery to do. There's a steep learning curve. So it takes a while to get proficient with this surgery, which is a downside of it, too, and is one reason a lot of people don't do this procedure. Again, like we talked about, it's difficult-- femoral exposure can be difficult. And when people say it's not muscle cutting, even though we do use this intermuscular and internervous plane, it's not truly not without cutting muscle. Because we do have to do some soft tissue releases to elevate the femur.

There's increased blood loss, has been shown in literature, and surgical duration. Especially during a surgeon's learning curve, the surgical duration can be increased. It's also difficult to address intraoperative complications from this. So one of the complications can be fractures of the greater trochanter, fractures of the femur.

And from a posterior approach, it's kind of our workhorse approach. It's really easy to extend that to address any complications. But from this approach, it's a little more difficult because you're kind of locked into this table. The incision that you use, if it's extended, it's a little more difficult to address any issues from that position. Whereas a posterior approach is much easier to address anything.

A lot of people use specialized equipment. So some people do this without that special Hana table, but most people use that table. It's an expensive table and not all hospitals have it. That's definitely a downside to it, as well. And it's not without the same risks as a posterior approach, too. So it's not the perfect panacea of hip surgery.

And a posterior approach, still a great surgery. Dr. Shields gave a great talk, and I agree with everything he said. We do a minimally-invasive posterior approach here, and it's a great surgery. Advantages includes it's familiar to a lot of surgeons. The majority of people train on this approach, and have learned this approach, and do this approach much more often than an anterior approach.

It's good femoral exposure. It's your workhorse approach. So again, if you have a complication or if something happens, your patient needs a revision down the road, it's a much easier approach to address any issue than an anterior approach. It can be used in all patients. There's not a patient who-- there are really no patient limiting factors, whether it's their size, or the shape of their bones, or any congenital abnormalities or dysplasia. And again, as Dr. Shields mentioned, we do a minimally-invasive adaptation to this, which does spare some muscles.

Disadvantages to that, lateral position does-- it disrupts the normal position of the pelvis a little bit and a patient's normal-- the normal position of their pelvis when they're ambulating. Whereas if they're supine, with the x-ray, you can actually see where their pelvis lies, and it helps with component positioning a little bit easier than having them in a lateral position.

The dislocation risk is higher with the posterior approach. It's about 1%, which is still very low, versus about 0.5% with an anterior approach. So you're kind of splitting hairs, but it is a little bit higher.

We do hip precautions most often with a posterior approach, but with the anterior approach, we forego those. There is a potential increase in leg length and offset, and potentially a longer, more painful recovery, as it does still disrupt some of the muscles.

In the literature, the literature supports what was just explained, that the operative time can be increased versus an anterior versus a posterior, especially in the early period. And when a surgeon is doing these, blood loss is greater in the literature versus from an anterior versus a posterior approach. There can be wound-healing issues, hematoma formation from an anterior approach, femoral shaft fractures, greater trochanter fractures, and nerve injury.

So there is a risk of nerve injury from that lateral femoral cutaneous nerve that we talked about. There is a risk of a femoral nerve injury because the femoral nerve is right there, as well. It's a little more medial than the lateral femoral cutaneous nerve. It's also a structure that can be disrupted or stretched from neuropraxia, or injured.

So these complications are still overall rare from an anterior approach, just like they are with the posterior approach. But they are a little bit higher in the anterior approach in the literature. So the slightly increased risk of complications in an anterior approach does come with the benefit that patients do seem to do better in the early post-operative period.

This nerve injury is kind of what we talked about. The lateral femoral cutaneous nerve can either be cut, or a neuropraxia sort of stress injury. Typically it comes back-- we give patients about-- we tell them about a year until they'll have basically the full recovery that they will get.

And wound problems-- the anterior approach, whether a patient has additional body habitus anteriorly, there can be wound-healing issues from that, or hematoma information, or seroma, which can cause some wound-healing issues.

So again, the dislocation rate for an anterior versus posterior is similar, but the anterior is less. The length of stay is decreased by about half a day to a day. Functional scores in the literature shows that anterior patients do return to function earlier. They do have improved muscle strength earlier. But at about the three-month mark, there's no difference. So if you were to see a patient that had an anterior versus a posterior approach, the majority of the time, they're going to be doing about the same at the three-month mark. And pain is decreased with an anterior approach in the early post-operative period.

So is this is the future? Are we all going to start doing this? Or is this kind of a flash in the pan? The other thing is that a lot of people note that, do patients who have an anterior approach, do they do better because it's patient selection, that these are patients who are maybe a little more active, a little more fit, a little smaller?

And also expectations. So if everyone's on the same page when we're talking in the clinic when the nurses are talking to them, when our physical therapists are talking to them-- if everyone's telling them, you're going to go home either the first or second day, and it gets in their head, that could be a motivating factor that these patients maybe doing better that way, too. But there are certainly more studies that can be done.

So the ultimate goal of the total hip, whether we're doing an anterior or posterior, is to do improve pain and function. We want to return a patient to the activities they enjoy, minimize complications, maximize the implant longevity and the implant positioning, and restore normal biomechanics.

So any approach will get you there. And again, a total hip is one of the best surgeries in medicine. So whether you're doing anterior or posterior, you'll get there. And I think one of the best things I heard from a talk when someone was giving it from an anterior approach, or a minimally-invasive posterior approach, is that at some point in time you'll get to the top of the Empire State Building during your recovery. But do you want to take the stairs to get there, or do you want to take the elevator? So you may get there a little faster with an anterior approach or a minimally-invasive posterior approach, but you'll still get there.