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Image-Guided Surgery

IMAGE-GUIDED OR COMPUTER-ASSISTED SURGERY

You are listening to ReachMD, The Channel for Medical Professionals. Welcome to Medical Breakthroughs from the University of Pennsylvania Health Systems with your host, Northwestern University Internist, Dr. Lee Freedman.

The surgical option that is least invasive and provides the greatest precision possible is certainly what we'd like to provide for our patients. Image-guided or computer assisted surgery is the wave of the now and puts the surgeon in the driver's seat. Joining me today to discuss image-guided or computer-assisted surgery is Assistant Professor of Orthopedic Surgery from the University of Pennsylvania Health System, Dr. Craig Israelite.

DR. LEE FREEDMAN:

Thank you so much for being with us Dr. Israelite.

DR. CRAIG ISRAELITE:

Oh! its my pleasure.

DR. LEE FREEDMAN:

Can you tell us a little bit about the general field where this is used? What exactly is total joint arthroplasty?

DR. CRAIG ISRAELITE:

Well with total joint arthroplasty also known as adult reconstruction, what we aim to do is take an arthritic joint, which is one obviously that does not have articular cartilage and through our surgical procedure, it's actually a resurfacing of the joint. It's called an arthroplasty and the goals are really to cut basically the bad bone and arthritis out, which is the cartilage loss and put on a new joint surface, either, a metal, plastic, or some other type of surface and the goals are to relieve pain, restore limb alignment and also restore their function.

DR. LEE FREEDMAN:

So it's certainly different than a total joint replacement.

DR. CRAIG ISRAELITE:

Well no, total joint arthroplasty and joint replacement, they are synonymous terms, but yes we are not cutting above and below and cutting the whole joint down. Essentially what we do is we trim off about 8 to 10 mm of bone about the knee or else we remove the femoral head of the hip joint and actually put metallic or plastic implants in those joints so that that new surface is now what's rubbing together rather than bone-on-bone.

DR. LEE FREEDMAN:

I see, I see and so I imagine that aligning things appropriately in the resurfaced or new joint is quite important?

DR. CRAIG ISRAELITE:

Well its very important, its one of the most important things that we do as surgeons. If we want to restore function and normal anatomy, but in addition we know historically that if these components are put in a malaligned position, they will not perform in the manner that they are supposed to and they also have earlier failure rates. There is one recent study, which showed up to about 11% of patients who had early revisions, the main cause were for malalignment. So correct positioning of these implants is critical to the benefit to the patient and for the long-term success of the joints.

DR. LEE FREEDMAN:

Well that certainly makes sense if it's not placed appropriately, the wear and tear will be not what it's designed for and lead to the problems that you outlined. How does this correct alignment, how do you obtain that in the operating room?

DR. CRAIG ISRAELITE:

Well currently and its been since probably the early 80s, there are cutting jigs that have been developed where after you make the incision and you get down to the joint, we have these really, jigs just like a carpenter would use and we either place them on the bone or in the intramedullary canal of the bone and these alignment guides will hopefully tell us within a reasonable degree of accuracy by visualization where to actually cut the bone and these have done quite well for the last 20 years or so with orthopedic surgery in joint reconstruction and still continue to do quite well, but what we are trying to do is develop a way that we can do better than these cutting jigs with only our own visual feedback to see if they are put in the correct alignment. So that's where we are now trying to move with this new development, or I should say newer development to help make sure that we are cutting the bone exactly where we want it to be cut.

DR. LEE FREEDMAN:

So this image-guided procedure is the new technology to make sure that the alignment is appropriate?

DR. CRAIG ISRAELITE:

Yes, so it's referred to numerous ways, either computer-assisted orthopedic surgery or surgical navigation or image-guided surgery, they are all different terms which mean the same thing. What we now do is we actually by marking the bone and going to either an image or image-free tracking pattern, a computer gives us instantaneous feedback by way of the visual picture to make sure that our alignment that we are cutting on the patient is the cutting alignment that we really want is a final result.

DR. LEE FREEDMAN:

It sounds like you would need a lot of infra kit, computer equipment, and other equipment to make these assessments?

DR. CRAIG ISRAELITE:

Well it depends on the system. Its actually not robotic surgery, which some people confuse in where a robot through a computer is making the cut. The surgeon here is really making the cuts very similar instrumentation that was used prior. The difference is the instruments now in the bone emits a signal to a computer, essentially there is a visual way to pick this up in the computer, which shows us a picture of really where our hands are, so in other words its almost like playing a video game where I am looking at the bone putting my hands in the equipment where I think it should be and then looking up the computer system and the screen and its showing me that what I think is correct is actually correct, but really there is not really that much more equipment. The way we do it is there are some pins that we actually place in the actual bone at certain locations and these pins with little balls on send a signal to a receptacle on this machine, which is at the foot of the operating room table and that's attached to the computer, so its really this one tower and then our normal instrumentation.

DR. LEE FREEDMAN:

Very interesting, and I would imagine that there needs to be sufficient training and practice using this type of equipment?

DR. CRAIG ISRAELITE:

Well like everything new, all new technologies, there is always a little bit of a learning curve and it's very important to know how to register the appropriate points on the human body accurately because computers will only spit out what information you give them, so if I don't do the checkpoints in an appropriate manner and haven't been trained to do that appropriately, the computer is only going to know what I tell it. You know it's not a free thinking enterprise, so it is very important to be trained and what we call place in the information appropriately, so the computer realizes the correct position.

DR. LEE FREEDMAN:

If you have just tuned in, you are listening to Medical Breakthroughs from the University of Pennsylvania Health System on ReachMD. I am your host, Dr. Lee Freedman and joining me today to discuss the use of computer-assisted surgery is Dr. Craig Israelite.

Dr. Israelite how long has this technology been available and has it been evolving?

DR. CRAIG ISRAELITE:

Well in orthopedics, I believe it began approximately 10 years or so ago in spine surgery, is where I think it was first developed, but over the last 10 years, there has been a huge growth in this specific technology to the point where although its not what I would say in routine usage, its fairly common place at most university centers, but over the last 10 years of development and technology, its now utilized in all fields of orthopedics from sports medicine, spine, even tumor surgery, but we have a great potential use for it in total joint arthroplasty.

DR. LEE FREEDMAN:

That makes good sense that it would be a major step forward. Given the 10-year experience, what specific improvements have we seen clinically?

DR. CRAIG ISRAELITE:

Well the bad news is that there is no long-term studies and that's because of the good news, which most total joint replacements have done exceptionally well, so we need 15 or 20-year followup to make sure what we think is going to happen truly does. What has been produced is a lot of data particularly on the knee side, which shows that the outliers which means that when we take a postoperative x-ray, the alignment is much more accurate and reproducible with the computer-assisted surgery <_____> without. So that's not to say that total joint replacement without computer-assisted surgery is a bad thing. In fact, as I said it has done extraordinarily well. What we are trying to do is make more accurate cuts that we think 15 or 20 years down the road are going to reproduce much better results, so its still in its infancy, but what has been shown clearly in the literature is we have the ability to remove some of the outliers in surgery and be able to more accurately place the total joint in the patient's body.

DR. LEE FREEDMAN:

Very interesting. So we certainly have to wait a little bit longer for definitive hard clinical endpoints, but this surrogate marker of joint alignment is very promising?

DR. CRAIG ISRAELITE:

Yes it is.

DR. LEE FREEDMAN:

Are there any risks to using this technology versus the more traditional way?

DR. CRAIG ISRAELITE:

There are some risks that are true risks and some that are indirect risks. So cost is actually one factor. The technology is expensive and so there is a cost factor. So even that, that's not necessarily what people cost as a risk, it is a risk to make more expensive technology available without, you know, what significant long-term benefit is. The other thing is it does take a little bit more time in the operating

room, so that's always somewhat of a risk to the patient. There can also be errors, so we as surgeons still have to not relegate our accuracy just to the computer. If we put in incorrect information into the computer, the computer will give us back incorrect information. So there is some human error involved and there has been a few reported incidences of you know infection at the pin tract sites as well as an occasional fracture. Again these are very rare, less than 1%, but they are true risks. So unfortunately there is no such thing as a free lunch. We have to continue to perfect the technique.

DR. LEE FREEDMAN:

In regard to the cost, are insurance companies commonly covering this or is this an out-of-pocket expense?

DR. CRAIG ISRAELITE:

Well the patients aren't charged for it. Unfortunately at least the way it is in most hospitals and in our hospital, we do not recoup the cost. There is no additional charge for the patients or the insurance companies at least at this point at the University of Pennsylvania. So we have elected and actually through a donation where we were able to achieve the computer and hardware, so we have the hardware that's been made available to us, but the time and the actual implementation unfortunately our health administrators don't like this, but we are not recouping the cost of this. Good news for the patients and the insurance companies, at least for now.

DR. LEE FREEDMAN:

And that's probably not uncommon for revolutionary or new technologies in many fields of medicine at University Hospital settings. In terms of clinical recovery for the patient, are there any advantages, is this less invasive, are they up and on their feet more quickly?

DR. CRAIG ISRAELITE:

There is the ability, because we now have better vision to do minimally-invasive surgery. So minimally-invasive surgery and computer-assisted surgery are not one and the same thing. Computer-assisted surgery you can use on everybody, doesn't matter if they are big, they are small and it has nothing to do with the size of the incision. Minimally-invasive surgery is a term that we use to describe procedures, which we use smaller incisions and less dissection so that patients could potentially get a quicker result because there is less surgical dissection. So what the computer-assisted surgery will allow us to do is give us that added vision that we are not necessarily able to see through the smaller incision, so it will enhance the minimally-invasive surgery.

DR. LEE FREEDMAN:

That's quite a step forward for the patients and if you are able to do more patients with the minimally-invasive technique that would be a great advantage.

DR. CRAIG ISRAELITE:

You know, we are still in the infancy of the process, but there is definitely progress made every year and more and more journal articles are coming out to show that there is a decreased learning curve. There is more reproducibility and therefore hopefully better outcomes for patients in long term.

DR. LEE FREEDMAN:

And if you look ahead, do you see any particular advances in the future with this technology?

DR. CRAIG ISRAELITE:

Well I do, I think that for one thing, the costs will come down, the amount of time it takes to register patients will be expedited and I think what it will do is particularly help the community orthopedic surgeon, who may do only 10 or 15 total joints a year. So this will be a good feedback for them to help them in a procedure that they do not do as often as some of the major centers. Additionally, I think it will also provide teaching tools, so that we will be able to train you know medical students or residents a little bit better with this computer assisted device because it will give them much more feedback, so they don't need to go through the learning curves of my generation.

DR. LEE FREEDMAN:

Well I want to thank Dr. Craig Israelite, who has taken us through the young, growing, and very exciting field of image-guided or computer-assisted surgery.

I am your host Dr. Lee Freeman and thank you very much for listening.

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