[MUSIC PLAYING]

RICHARD DALY: Hello, welcome to this video about mitral valve repair using the robot in a minimally-invasive manner from the Mayo Clinic. I am Rocky Daly, and I'm a cardiac surgeon at the Mayo Clinic in Rochester, Minnesota.

To begin with, we disclose our activities. I am involved with, as an inventor, in a couple of projects for mitral valve repair. But these have nothing to do with the robot and are currently under investigation.

With the robot, we're repairing mitral valve regurgitation, which is related to leaflet prolapse. There are different causes of mitral regurgitation. But what we'll be talking about today is leaflet prolapse or degenerative mitral valve disease. This is a three-dimensional echo which shows the bottom part of the valve right here with ruptured chordae tendineae and prolapse of this portion of the valve.

Even if patients don't have symptoms, they can have excess mortality over time when they have this disease process and they have severe mitral regurgitation. This shows survival of patients that have mitral regurgitation due to leaflet prolapse compared to a normal population. And you can see that there is an excess mortality.

If patients develop symptoms even if they have normal cardiac function, they can have an excess mortality compared to what's expected. But if we intervene and fix the valve before the symptoms are severe and while the heart is still functioning well, the patients will have a normal survival compared to the rest of the population. So the disease process is essentially suppressed.

There is enough information about repair of mitral regurgitation now for there to be guidelines, which have been developed by the American College of Cardiology and the American Heart Association, for indications for surgery. And this includes indications for even patients that have not yet developed symptoms.

Mayo Clinic has really a vast experience with mitral valve repair. This is the number of mitral valve repairs per year going back several decades. And you can see, there are over 8,000 mitral valve repairs now at the Mayo Clinic.

Now, we have the robot, which, with this technology, allows us to do the procedure in a minimally-invasive way and still preserve the same techniques that we have used over decades. Our experience with mitral valve repair at the Mayo Clinic is here. It began in 2008. And we had a lower number as we changed surgeons occasionally. But we are over 100 cases per year now, and we have considerable experience. We've had experience with over 700 cases.

This is the incision for a standard repair of the mitral valve in a conventional manner. It's a median sternotomy. And this is really very good for surgery. It has been the standard for decades. Sometimes, we can do this surgery through a small thoracotomy on the side.

But with the robot, we can manage it through several very small incisions. Here is the working port here. And you can tell that we have reached a point of very small incisions now thanks to the technology.

The thing we do want to do is maintain very good outcomes. And that means that we need to select patients properly. Some patients are not a good candidate for this. We want to avoid shortcuts. We use the very same technique that we use with a standard, conventional, open surgery.

And we monitor and control what's our outcomes. All patients get a CT angiogram in advance to make sure that they can have femoral cannulation for cardiopulmonary bypass and that it will be safe to go ahead with the robot approach.

There are three of us at Mayo Clinic that are involved with these operations, with the robot operations-- myself, Rocky Daly, and my colleagues, Dr. Joe Dearani and Dr. Simon Maltais. At every surgery at Mayo Clinic, we have two of us scrubbed and involved with each surgery. And so what we have is one surgeon-- in this case, this is me at the bedside, working with the patient, and Dr. Dearani, who is at the remote console for the control for the robot arms. We're very interchangeable.

And this is prior to the surgery now. And we are evaluating the echo with our colleagues from cardiology. This shows a leaflet prolapse in a two-dimensional echo. And here's the leaflet that's abnormal. You see it's coming up too high above the anterior leaflet, which is at a normal level. And that results in this regurgitant jet of mitral insufficiency that's eccentric and directed along the colors that you see here.

Our incision for the robotic approach is just big enough so that we can see and work. And then we make several small incisions for the robot arms, as well as for a cannula and for a retractor.

As I mentioned, one surgeon works at the robot remote console. And as the surgeon moves his hands underneath the-- you can see here-- those movements of the hands and fingers are very precisely transferred to the robot arms inside the chest of the patient.

Here's my colleague, Dr. Maltais. And he's at the bedside next to the patient. And you'll see the robot arms moving as the surgeon sitting at the console moves the controls which we just showed. You see the arms moving. Dr. Maltais can see, up on this screen, the robot arms moving as well.

Our technique for mitral valve repair is very standardized. We do the same technique that we use with a standard, conventional, open surgery. This shows posterior leaflet prolapse with a flail segment. And on the posterior leaflet we can excise this flail segment, which is shown here.

It's a triangular type of excision. And then the leaflet is reconstructed with running monofilament suture. And all of the repairs are supported with what's called an annuloplasty. This is a band which is used to support the annuloplasty. And the band just spreads out tension on the sutures and brings the leaflets closer together so that they coapt for a deeper distance and to have better support.

This is post-operatively. We're looking at the echo with our colleagues now and studying to make sure that we have a good repair. A close-up of the repair is shown here. You see that the leaflets no longer have one of the leaflets riding up in the air. And if we look at the color, there's no color going backwards from the valve. So this is a nice repair.

I mentioned that we have to be careful about patient selection. And there are some contraindications to using a minimally-invasive robot approach. If the patient needs other surgical procedures on the heart, except for a few exceptions, such as closure of a patent foramen ovale-- sometimes we can do tricuspid valve repair at the same time, or a maze procedure. But other surgical procedures on the heart would require an open procedure.

If the patient's had previous cardiac surgery or right thoracic surgery, then it's not possible to approach with a robot. They do need to have competent aortic valves. Mild aorta regurgitation

or enlargement of the ascending aorta can create difficulties during a robot approach.

We need to support the patient on their single lung before and after a cardiopulmonary bypass. And so they need to have a minimal amount of lung disease. We do cannulate the femoral vessels. And as I mentioned, we do a CT scan to make sure that's safe. But if there are any concerns, then we should not use this approach.

Extreme obesity can be a complicating factor with these minimally-invasive approaches. And we make this decision on an individual basis. Severe left ventricular dysfunction can be a problem in terms of being able to provide good protection to the heart. And we may find that some of these are best not done minimally invasively. And scoliosis can bring the ribs together in a way that may make it not possible to approach the right side.

Depending on the position of breast implants, that can be an issue for the right surgery, right-sided chest surgery. And mitral annular calcification, pulmonary hypertension, or liver dysfunction are relative contraindications. Decisions are made on an individual basis.

We have experience, as I mentioned, with over 700 robot-assisted mitral valve repairs now at Mayo Clinic. We have had a 100% repair rate with these. And we've had no conversions to sternotomy. There have been very few major complications, less than 1%.

With the robotic approach, we've had shorter ventilation. The patients are almost all extubated in the operating room. And we target a hospital stay of just three days. At the time of hospital discharge, all of the patients have had mild or less mitral regurgitation.

Durability of the repairs has been studied. And this is durability out to 10 years and need for mitral reoperation. This is need for reoperation with anterior leaflet repair, with bilieaflet repair, and with posterior leaflet repair. And you can see with posterior leaflet repair, which is most common, the need for operation is exceptionally small. In fact, it's actually less than the need for reoperation for mechanical valves, which are felt to be permanent.

We've done some other operations that I mentioned with the robot. We've had patent foramen ovale closure in 15% of our patients. We've done left-sided maze procedure in 55 patients; tricuspid valve repair, either as an isolated procedure or combined with mitral valve repair in 10. In 10 patients, we've done tumor resections. These are isolated tumors. And ASD closure in six, and an Amplatz device removal in one patient.

One of the benefits of robotic approach or minimally-invasive approach is the recovery time.

This shows return-to-work with a robotic approach compared to return-to-work with an open mitral valve repair. And the percentage of patients at three months that have gone back to work is higher with the robotic approach.

So the outcomes have been similar to an open repair. This has been a safe and efficacious way of fixing the mitral valve. We do use the same technique that we would use in an open repair, so we understand very well the durability.

The bypass and cross-clamp times are similar to open repair. The length of stay is reduced. We do target about three days in the hospital. And cost has been similar or reduced due to the lower hospital length of stay.

So in conjunction with my colleagues, I want to say thank you for taking the time to view this video.