[MUSIC PLAYING]

BERNARD R. BENDOK: I have never been more hopeful than I am today about the future of brain tumor therapy. There are many incredible advances that are occurring on the surgical front for brain tumors. The first and most important is-- before we even get to surgery-- is the idea of simulating the surgery and individualize the brain map.

JONATHAN M. MORRIS: We have the latest in stealth navigation, which means all of the high-tech images we acquire in neuroradiology, including where all the important information flowing in your brain is next to your tumor, we can import that data into their neuronavigational software, so when the surgeon's operating, he can be looking exactly of where all the important structures are while he's inside the brain.

TERENCE C. BURNS: Mayo has been a pioneer in the use of inttraoperative MRI suite and awake mapping techniques to make sure that the patient's function is preserved while removing the maximum amount of the tissue, because we know with increasing certainty that the more tumor that is removed, the better the patient's long-term outcome. The intraoperative MRI allows us to have millimeter precision even in the deepest areas of the brain after part of the tumor has been removed and the brain has shifted.

BERNARD R. BENDOK: We can create an individualized brain map based on the patient's function. So if a patient moves her or his right arm, we can see where that lights up in the brain. If an individual swings a golf club, we can see what parts of the brain light up, so we can preserve that function, which is-- may be very important to a certain patient. And we can then take that map to the operating room.

Another very important technology we're looking at is confocal imaging and Raman spectroscopy, where we can visualize a tumor down to the cell level. We're also looking at fluorescent imaging, where we can give patients agents before surgery, but then, at the time of surgery, show-- all the tumor light up in color.

So we're entering now the era of cellular neurosurgery, where we can see individual cells, and that is going to make our surgeries much more precise and much more effective. The way we're doing it now is through augmented reality and holography. So we can build a hologram of patients' brain map, and we can update that data in the OR so that a surgeon is no longer just looking at the tumor, but actually overlaying information-- biological information, functional information, and mapping information from the operating room to give us the most intelligent way to get to the tumor and the most intelligent way to take out as much tumor as possible safely while preserving normal tissue.

JONATHAN M. MORRIS: 3D printing has helped advance a lot of skull base applications. And it helped advance-- patients also understand their tumors, because when we're talking to a patient who has a brain tumor, we're usually showing them an MRI, which most laypeople cannot understand. But when we 3D print their skull with their tumor next to their blood vessels, we use that physical object to say this is you. This is what we're going to operate on. This is the risk, because it's next to this structure.

And I think from an informed consent purpose, the patients are really appreciative. We've spent a lot of capital resources, or money, to get the latest and greatest equipment at Mayo Clinic so that we can do a better job. For example, we have the first 7-tesla MRI that works clinically.

JAMIE J. VAN GOMPEL: 7-tesla is a really critical clinical tool, because it's allowing us to see things that we couldn't see before. 7T is a tesla strength, so most of the clinical magnets that are in the MRI are 1.5 or 3T currently. There's a lot of 7T and higher T MRIs out there in the United States that are experimental. That a 7T MRI that's available at the Mayo Clinic, at least at this point in time, is the only one in the United States that's clinically approved to scan patients on for any indication.

BERNARD R. BENDOK: When it comes to surgery, our approaches are getting less invasive. Our ability to individualize our brain maps is getting better every day. New therapies are coming online, including more advanced intraoperative MR techniques, robotics, augmented reality, and fluorescence.

We have been doing work on using less invasive approaches to brain tumors and mapping higher-level functions, including music and cognitive abilities, during surgery to give patients the best possible outcome. We're also looking at new cameras that will allow us to see individual cancer cells during surgery, which will allow us to get a much better result, a much more complete result, and a much safer result for our patient.

ALFREDO QUINONES-HINOJOSA: Before we used to have to do large craniotomies or large openings to be able to take care of tumors. Nowadays, with surgical navigation or the intraoperative MRI technology that we have available here at the Mayo Clinic, we can tailor openings much smaller, so that patients could go home faster.

The second one is the fact that we used to have to do very large skull base openings where we had to dismantle the face open, move things-- nowadays, we can actually go through the nose, use a spatial [INAUDIBLE] cameras, and we have evolved here at Mayo Clinic in the techniques that we can use to be able to go through the small orifices, small openings, so that way we can take out these complex tumors.

We do a lot of our craniotomy with the patients awake. And you think, oh my gosh, that's very scary. Turns out that those patients, not only do they go home faster, the resections of their tumor are much more thorough. Therefore, their survival is even longer. Their quality of life is even longer. We can now map the brain in the operating room and preserve function in the arm, leg, face, speech, understanding, vision.

BERNARD R. BENDOK: We are always thinking through our research, through our clinical trials, through our team collaborations, on how to improve care, whether that's designing a new surgery, designing a new protocol for radiation therapy, or looking at new medical therapies for brain tumors. And then how do we make it all fit together?