KAREN ANDREWS: Hi, I'm Karen Andrews. I'm the director of Amputee Rehabilitation Services at Mayo Clinic, and I'm going to talk today about rehabilitation following upper extremity amputation.

First, when somebody has an amputation, these days about 90% of upper extremity amputations are related to trauma-- and so primarily trauma. There will be two phases of rehabilitation. One will be the acute phase, and the other will be the subacute phase. The acute phase while the patient is in the hospital-- that usually takes about five days. During that time we're working with pain control, edema control, and obtaining a detailed history of what the person with the amputation did prior to the amputation. Did they like to garden? Did they like to fish? Did they like to play golf? And then we can gear our therapies towards optimizing their function.

Helping the person who lost their limb cope with the loss of a limb-- losing a limb is a devastating loss. It's like losing a loved one. But part of the fear is related to the fear of the unknown. And so we provide patient education materials, provide options to meet with a peer visitor to help discuss what to expect following amputation, and we've found that to be very helpful.

The first prosthesis that a patient will receive is a provisional prosthesis. It's not going to have the weight, bells, and whistles as the final arm, but it allows them to use their prosthesis and become adept at bimanual activities. After their residual limb is healed, we proceed with their first prosthesis which is typically a body part prosthesis. Once the residual limb is volume stable, about six months after the amputation, we can start myoelectric fitting.

Prosthetic fitting as a process. We hope that at the end of the process, the person using the prosthesis is successful and will successfully use their prosthesis in a smooth way with no awkward movements and really incorporate it into their life. In order to achieve that, we really need the patients to be involved in the process early on. There have been studies that have shown that if you're fit with a prosthesis within 30 days of the amputation, you're going to be more successful in using the prosthesis and returning to work. So we try to fit people as quickly as possible-- ideally while they're still in the hospital.

After discharge from the hospital, the subacute phase of rehabilitation starts, and that includes preprosthetic management, prosthetic management, and then optimizing function. So optimizing daily living activities, both with and without the prosthesis. We have a great video out on YouTube, life following upper limb amputation, that I would encourage you to view or encourage you to have your patients view to help them see what to expect following amputation.

Advances in prosthetic rehabilitation include socket design, components, the terminal device. Terminal devices can be faster, waterproof, stronger grip. When engineers are trying to develop advances for prosthetic rehabilitation, it's important for them to think of components that are as lightweight as possible, as fast as possible, and have as strong of a grip as possible.

You probably remember the story of a father that used a 3D printer to make a hand for his son that now is somewhat of a comparator that engineers are faced with-- something as lightweight as that. Obviously, with experience in research and development, the components are a bit more high-level than what you can make on a 3D printer, but there are some advances with technology these days.

There have been a lot of research on optimizing inputs to the prosthesis. One optimization would be the brain-machine interface. So taking signals from the motor cortex to optimize the function of a prosthetic hand. There is also targeted muscle reinnervation. The targeted muscle takes a muscle that's targeted, deinnervated, and reinnervated with the nerves that would have distributed to the amputated limb. By using this targeted muscle then, the EMG from the muscle represents the signals that would have previously gone to the hand to function the prosthesis. There's also been studies looking at implanting electrodes directly into a patient's nerves to help facilitate the signal from the brain to the prosthesis.

At Mayo, we're working with Arizona State University and Italy ITT to develop a robotic hand for people with upper extremity amputations. ITT developed the soft-hand robotic hand which has unique grasp, and we're hoping to incorporate that for people with amputations.