Will Human Hand Transplants Become Standard Practice?

Lead surgeon in first successful transplant is hopeful

by Scott McNutt

Human hands have 28 muscles, 27 bones, 3 main nerves, and 2 main arteries, not to mention skin, veins, tendons, cartilage, fat, and blood vessels. Proposing to transplant a hand from one body to another may sound like science fiction. But in 1999, Matt Scott of New Jersey became the first recipient of a successful hand transplant in the world. Jerry Fisher of Michigan became the second recipient in the United States in 2001. Several other countries report successful transplant operations as well. In total, 24 hands have been successfully transplanted on 18 different people around the world.

The hand transplant procedure was developed by a partnership of physicians and researchers in Louisville, Kentucky, at Jewish Hospital, Kleinert Kutz Hand Care Center, and the University of Louisville. The lead surgeon on the team that performed the transplants was Warren C. Breidenbach, MD, a hand surgeon with Kleinert Kutz and assistant clinical professor of surgery at the University of Louisville. Other patient care team members have included Jon W. Jones, Jr., MD, Frederick R. Bentley, MD, Darla Granger, MD, Martin M. Klapheke, MD, and Jeffrey Thomas Omer, MD.

A hand transplantation requires large surgical and anesthesiology teams. For instance, an 18-member surgical team and a five-member anesthesiology team conducted the second U.S. hand transplant operation. The surgery can last from eight to 14 hours. (By comparison, a heart transplant operation averages six to eight hours.) Adding to the challenge is the need to match donor and recipient by a variety of attributes such as gender, skin tone, race, age, viral status, hand size and blood type (although only blood type and size are mandatory considerations). Given all this, it might appear that a hand transplantation is an almost impossible undertaking. But appearances can be misleading.

According to Breidenbach, the surgery team leader, hand transplantations are built upon years of work and research by many doctors. And although the operation is technically demanding, hand transplants are not miraculous. “The public may have this perception that we did some type of miracle, attaching a hand here,” says Breidenbach. “Many pioneers before me worked out the problems of reattaching amputated parts. I learned from them.”

Surgeons have been reattaching (called “replantation,” in contrast to transplantation) amputated body parts for nearly half a century. Breidenbach says that when the Louisville team did the first hand transplant, they were drawing from a prior body of knowledge and using techniques that they had been using in replantations for many years. Thus, most of the technical issues of reattaching a hand had already been worked out before a transplant was attempted. The difference, obviously, was that, rather than reattaching the patient’s own hand, the hand came from a donor who was brain dead.
The Immunity Syndrome

While much work and research have been done over the last four decades on hand replantation and transplantation, much remains to be accomplished. One area that Breidenbach has focused on is developing better methods of managing the immune system’s reaction to a hand transplant.

Early attempts at hand transplants failed because the recipient’s immune system rejected the tissue of the transplanted appendage as a foreign invader, in the same way your immune system would fight off an infection. The development of the drug cyclosporine, which inhibits the body’s immune system to prevent rejection of transplanted organs, facilitated much higher success rates with transplants. Currently, however, hand transplant recipients must anticipate that they will never be able to stop using the drugs that suppress their immune system for the life of the organ (i.e., the hand).

Breidenbach is researching how to manage the immune system to keep a patient healthy with a live, functioning transplanted hand without using immunosuppression agents like cyclosporine or FK506. “We are working on methods of manipulating the immune system to reduce the amount of drugs they take, with the eventual goal of being able to eliminate all drugs,” he says. “In the laboratory, I can do that on a small animal model, but we have not been able to get there completely, certainly not in a hand transplant clinical setting with patients.”

Awaiting Further Developments

People born without a hand or who have lost hands to illness will have to await more breakthroughs before they can become candidates for a hand transplant procedure. “In our protocol, we need a patient who has a very specialized level of amputation and is healthy and is an adult,” says Breidenbach. “We would prefer to transplant someone who is healthy because having a hand transplant and taking an immunosuppression agent can stress the immune system. We’d rather take someone who is very healthy to a little bit less healthy stress state than someone who is already unhealthy.”

The possibility of transplanting whole arms or other limbs also depends upon future developments. This is because the farther up the arm the amputation is done, the more damage there is to structures that are difficult to repair and reattach. Therefore, the higher the amputation, the less functionality a reattached limb is likely to have.

“When you cut off the hand at the wrist, the muscles that make most of the fingers move are all still on you,” says Breidenbach. “When you cut off the arm at the level of the elbow, you cut off all of the muscles that move the hand. So you have to reattach that elbow, and then the nerve has to grow back properly into all the muscles. That doesn’t always happen.”

Standard of Care?

Breidenbach hopes that hand transplants will become more of an established option for amputees. He points out that data from the use of immunosuppression agents in other organ transplants, such as kidneys, provide strong evidence that future hand transplants will only require comparable levels of immunosuppression. This data, coupled with the high, ongoing survival rates of current hand transplants, means it is possible that hand transplantation could be considered as a possible standard of care, albeit for a small pool of potential candidates at this time.

“It has to be an amputation at the right level,” Breidenbach says. “It has to be a patient who has a willingness to take risks, to trade the risk of complications down the line in exchange for quality of life. So we are going to look at the health of the patient, we are going to look at the motivation and why they want it. We’re going to look at the type of gain they are possibly going to get from it. So even though I think it is something that could be a standard of care, it is still a standard of care for only a very select number of patients.”

As better drugs and surgical techniques improve the success of hand transplantations, the procedure may become one of the options discussed by an amputation patient’s medical team. Such discussion is critical, because in the case of a hand amputation, to get the best fit for a prosthesis, cutting farther up the arm rather than at the wrist would be appropriate. However, for a hand transplantation to remain an option for the patient, as much of the arm’s length as possible needs to be preserved.

“Cooperation between the different services that treat these types of patients is what is necessary,” says Breidenbach, to ensure that preserving the arm length and other factors relating to transplantation are considered when making decisions about hand amputations.

In the meantime, Breidenbach will continue performing replantations and transplantations, raising awareness about transplantations and working to reduce the immunosuppression agents involved with the procedure to make hand transplants more viable. “We have to disseminate information slowly and carefully, and we have to go cautiously with selecting those few patients who are good candidates,” he says. “I think, over the next number of years, we will see the risk reduced, better and better drugs that cause less problems introduced, and more and more tissues being used to be transplanted.”

For more information, please visit www.handtransplant.com or call the Hand Transplant Coordinator at 502/562-0313.

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