Why hand transplantation?

Upper extremity loss from trauma, tumors, infections, and vascular complications affects thousands of people each year. For most people, upper extremity prosthetics are able to facilitate functional independence. However, even the most advanced prosthesis provides only limited motor function and is unable to provide sensory feedback. Hand transplantation is able to restore the appearance, sensation, and function of a native hand, ultimately leading to an overall improvement in one’s quality of life.

Your hand transplant evaluation

Should you decide to pursue hand transplantation, your transplant evaluation provides an opportunity for you to learn about hand transplant surgery, to find out what to expect afterwards, and to weigh the benefits and risks of transplantation to help you make a well-informed decision. It is also an opportunity to get acquainted with your Hand Transplant Team. Your team will include the following: a hand transplant surgeon, transplant surgeon, transplant nephrologist, transplant coordinator, social worker, pharmacist, dietitian, infectious disease specialist, financial coordinator, psychiatric team, and occupational (Hand) therapists.

The transplant evaluation consists of a series of physical examinations, tests, and consultations that are conducted to determine if you are, otherwise, healthy and free of other serious problems that would limit the success of transplant. The evaluation may reveal certain conditions that may need to be treated prior to transplant surgery. It may also reveal certain conditions that would make the transplant surgery and post-transplant medication dangerous for you. The Hand Transplant Team wants to make sure that hand transplantation is a good option for you.

Hand Transplant evaluation consists of multiple phases. The first visit is an initial consult with the hand transplant surgeon, transplant nephrologist, and social worker. Once agreed that you would be an appropriate candidate, the second phase occurs, where you will meet the majority of the transplant team. The coordinator will provide a slide show about the transplant process and include a question and answer session. Transplant candidates are encouraged to bring a support person to these initial visits. The third phase consists of meeting with a psychologist and psychiatrist for a full psychological evaluation (further discussed in Psychological Evaluation). Once you have successfully completed the initial evaluation, you will meet with Occupational Therapy (further discussed in Occupational Therapy). The final phase consists of necessary radiographic imaging (see Radiographic Imaging) and any other testing recommended by any of our initial team members.

Psychological evaluation

Receiving a hand transplant is unlike a solid organ transplant, due to the fact that your transplant is visible to you. Losing one’s hand evokes both a psychological and physical response, which can affect one’s sense of self and body image. Not unlike solid organ transplant, however, one may struggle with the idea of having their new hand come from someone who just passed away, leading to feelings of guilt and discomfort. Assessing one’s coping skills and support system is an important aspect of the evaluation, as is evaluating the risks versus benefits of undergoing hand transplantation.

You evaluation will consist of testing from both a psychologist and psychiatrist. You will not move forward with your evaluation until you have received clearance from your psychological evaluation. During this process, they may recommend counseling to help prepare you for transplantation.
Radiographic imaging

Chest and Upper Extremity X-Ray: (Chest) To determine the health of one’s lungs and respiratory tract; (upper extremity) to view and determine anatomy of extremity being considered for transplantation.

CT angiogram of Upper Extremity: Provides imaging of vasculature and adjacent bone and soft tissue. Will include injecting dye through an IV to illuminate the blood vessels.

Functional MRI: To identify cortical brain activity pre and post transplantation. This will be done annually post transplant to evaluate activation within different parts of your brain as your new hand “re-awakens” the parts of your brain not used since your amputation.

Musculoskeletal MRI of Upper Extremity: To assess soft tissue and musculature within the extremity for atrophy, contracture, or fibrosis scarring.

DEXA (bone density) scan: To assess baseline bone density prior to transplantation. This will be done annually post transplant due to changes in your bone density related to the medication you will be taking for your transplant.

Other tests

Cardiac testing: Includes an EKG, which measures the electrical signals that control the rhythm of your heartbeat. May include an echocardiogram that takes images of your heart and evaluates heart size, valve function, and measures the amount of blood pumped out of the heart with each beat. May also include a stress test (exercise tolerance or dobutamine) which measures one’s heart function when it has to work harder than normal. A positive test may indicate your heart has inadequate blood flow.

Ultrasound of Upper Extremity: To evaluate upper extremity venous system and rule out any pre-existing blood clots.

Laboratory Tests: This will include determining blood type, identifying any past or current viruses/infections, blood counts, electrolyte levels, and urine samples.

Routine Health Screenings: Women should have PAP smears regularly and if over the age of 40, should also have routine mammogram screenings. A colonoscopy is recommended for men and women over the age of 50.

Dental Examination: Must receive dental clearance prior to proceeding with transplantation. Any major dental work should be completed prior to listing on the transplant list. Annual dental exams are encouraged.

Tissue Typing or HLA: This blood test looks for the six histocompatibility antigens on the surface of body cells and tissues that will define the amount of “matching” between a recipient and donor. Checking the antigens can tell if donor tissue is safe (compatible) for transplant to another person. This test may also be called HLA typing. Antigens can tell the difference between normal body tissue and foreign tissue (for example, tissue from another person’s body). This will help find the best match for tissues or blood cells.
Panel Reactive Antibodies (PRA’s): Panel reactive antibodies show a patient’s level of sensitization to donor antigens. Patients with high PRA levels tend to have more rejection episodes. In addition, it is more difficult to identify a compatible donor for patients with a high PRA level. A PRA test will be performed early in the evaluation phase, with a follow-up check 1-2 weeks after the initial test to ensure accurate results.

After the evaluation

After your transplant evaluation testing and consultations have been completed, your case will be presented to the Hand Transplant Selection Committee. This committee consists of the multidisciplinary Hand Transplant Team. The team will review your evaluation testing and determine if transplant is the best option for you. The transplant coordinator will contact you to discuss the results/decision of the committee.

Occupational therapy

Occupational therapy (OT) plays a crucial role both pre- and post-transplantation. During phase three of your evaluation, OT will perform tests to assess your baseline functionality, and will be performed annually post transplantation:

Carroll Test: This test quantifies functional capabilities of your upper extremities on a scale of 0-99, with a score of less than 50 being considered “poor” and greater than 85 as “excellent.” The test assesses what basic upper extremity functions you are able to do prior to transplant.

Michigan Hand Outcomes Questionnaire: This questionnaire is designed to assess one’s perceived and actual hand function, and will be used yearly to assess for improvement or regression. Sections of the questionnaire assess for the following: activities of daily living, overall function, work performance, visual appreciation of the hand, and overall satisfaction of functionality.

DASH (Disabilities of the Arm, Shoulder, and Hand): This questionnaire assesses your ability to perform certain activities related to your arm, shoulder, and hand. After listing, you are expected to receive therapy on an outpatient basis 1-3 times a week, to strengthen your upper extremities, getting you ready for impending transplantation.

Post transplantation, the demands for hand therapy with an occupational therapist increases, with daily therapy occurring on an inpatient basis, then, up to six hours a day, five days a week being the expectation for therapy on an outpatient basis.

Your compliance with hand therapy will be a key factor in the success of your hand transplant.
**Hand donor sources**

Hand donors are the result of a generous donation by the family of a brain death victim. Certain criteria include: free of communicable disease (viral and bacterial), no current/recent IV drug abuse, no tattoo on the potential transplanted limb nor may they have a non-professional tattoo anywhere on their body, or any disease process involving severe impairment of connective tissue, bones, or joints (e.g. rheumatoid arthritis, osteoarthritis). This donor must also have a compatible blood type with you, as well as no antigens perceived as harmful via HLA testing. At this time, the average wait time for a donor after listing may be anywhere between one to three months.

**Transplant surgery**

After an appropriate donor has been assessed, you will be called into the hospital by the coordinator. The Transplant Team will do a final medical examination to make sure you are healthy enough to undergo surgery. You will have more lab tests drawn, as well as a chest X-ray and EKG. We will then wait for a sample of the donor’s blood to run the HLA test, which is called a **cross-match**.

**Cross-match:** Establishes compatibility between a particular donor-recipient pair. A “negative” cross-match suggests that a donor and recipient are compatible and the transplant can proceed. If the cross-match is “positive,” the transplant will be cancelled because there is a high likelihood that you will immediately reject the donor limb. This tends to happen more frequently in patients who have a high PRA level.

Once the pre-op testing is completed and a negative cross-match has been confirmed, you will be taken to the operating room where, after receiving a general anesthetic, you will quickly fall asleep. Prior to this you will receive a catheter/regional block to control postoperative pain. The surgery may last anywhere between 12-18 hours, with two to three surgeons working on each limb involved, including the actual donor hand(s). This delicate surgery involves bone fixation, reattachment of arteries and veins, and repair of tendons and nerves. Because of how lengthy the surgery is, you will receive numerous blood products and fluids to ensure your body maintains a normal state.

Post-surgery, you will arrive in the intensive care unit (ICU) where they will closely monitor vital signs, urine output, and monitor for any issues with your newly transplanted hand(s). You will receive pain medication, should you need it. You will have an implanted device attached to either an artery or vein of your new limb that ensures blood is flowing properly. Your hand transplant surgeon will be performing daily dressing changes to your transplanted extremity.

Occupational therapy and physical therapy will be assessing your needs early post transplant. Occupational therapy will begin performing shoulder, and later, hand exercises and will develop different splints to mobilize your hand in different positions. Physical therapy will assess your swelling and ensure you are able to walk around, with the assistance of a special walker that will allow you to walk comfortably while keeping your transplanted extremity protected.

After about one week, you will transition to a general ward room. Your Transplant Team will be rounding on you regularly, and you will receive education regarding post-transplant care from your transplant coordinator, dietitian, and pharmacist. Your transplant medication regimen will be emphasized and reviewed in great length to ensure you understand what the drugs are, what their purpose is, and establish the times you will be taking them.

*Your length of stay in the hospital will be about 21 days.*
Maintaining a healthy transplant

It can be overwhelming to think of all the things involved to ensure a successful transplant. You will have to accept the fact that in the beginning, you will not be able to care for yourself in the same way you may have been able to with prosthetics. Activities that had become routine such as eating and toileting yourself will need to be done with full assistance. This is necessary as the functional return of your transplanted hand(s) will not be immediate and will take time and intense therapy.

Altered Circulation: Clots may form within your hand’s blood vessels, which may compromise blood flow to the hand. It is important to recognize the signs of poor blood flow, which will be taught to you after the transplant by the transplant coordinator.

On top of that, you will be trading in the lifestyle of a “medically well” person to that of a “transplant” patient, which carries its own set of potential complications:

Rejection: Transplant rejection occurs when the immune system of the recipient attacks the transplanted tissue. Rejection is diagnosed with a biopsy. However, unlike solid organ transplant which can present with a rejection in a delayed fashion, you will be able to see early signs of rejection and treat it promptly. These signs include a rash throughout your hand and/or scaling and thickening of the fingernails. Other signs of dysfunction may include swelling or discoloration to your donor limb. A change of medication is usually enough to reverse rejection. It is very important to continue taking your medication as prescribed by the doctor.

Infection: Because your immune system is suppressed with the anti-rejection medications, you are at an increased risk for all types of infection. The risk of infection is the greatest in the first few months post-transplant, but the risk will remain throughout your life. Some of the signs and symptoms of infections may include: fever, headache, open sores and lesions of extremities, sore throat, cough, shortness of breath, vomiting or diarrhea, and stinging/burning with urination.

Diabetes: Anti-rejection medications may cause diabetes. If you have never been diagnosed with diabetes, you may develop it post-transplant and may have to start taking medications to control your blood sugars.

Cancer: Skin cancer is the most common type of cancer post-transplant, followed by lymphoma. You can also develop other types of cancer, such as: breast, colon, lung, prostate, brain, and others. For this reason, it is important to keep annual health maintenance appointments.

Psychosocial: Hand transplantation can be stressful for both you and your family. You may experience stress which may lead to depression, body dysmorphic disorder, changes in inter-personal relationships, and finances. The transplant social worker can help you deal with these psychosocial issues.

Medications: The Key to a Healthy Transplant

The immunosuppressive (anti-rejection) medications are needed to maintain a healthy transplant and are a critical part of life post-transplant. Your medications will be continuously monitored and adjusted, so it is important to keep in close contact with your transplant coordinator to be aware of these changes. The following medications will be part of your anti-rejection regimen:
Tacrolimus (Prograf, Protopic [topical]): This will be one of your primary anti-rejection medications. You will have to have regular labs drawn to ensure this medication level is therapeutic and not too high or low. Too high a level may result in headaches, tremors, and increase the potassium level in your body. Too low a level means there is not enough of the medication in your system, and you are at risk for rejection. Other complications include: high blood sugar, impaired kidney function, increased susceptibility to infection, burning and itching on applied site [topical], and cancer.

Mycophenolate mofetil (MMF)(Cellcept): Another important anti-rejection medication, common complications include: leucopenia (low WBC count) which leaves you more susceptible to infection, nausea, vomiting, diarrhea, abdominal pain, and high blood pressure. Some patients may not tolerate Cellcept, and a different medication of the same class may be substituted.

Prednisone: This is a steroid. This medication will be given in high doses initially; however, it will be weaned down to a minimal amount after a certain number of days post-transplant. Steroids help to calm the inflammatory response within the body. Complications may include: psychic disturbances, edema, impaired wound healing, Cushingoid symptoms with long term use (e.g. “moon face”), and high blood sugar.

Sirolimus (Rapamune): This anti-rejection medication will be introduced at about a year post transplant, while Prograf gets weaned off. Sirolimus has been found to possibly inhibit abnormal cell growth, cancers, and lowers renal side effects from the other medications (Tacrolimus). You will have regular labs drawn to ensure this medication is maintained at therapeutic levels in your body.

Lab, Tests, & Other Appointments: Monitoring Your Hand’s Function

After transplant, regular lab tests will be drawn to monitor drug levels and to ensure no harm is being done to your other organs. You will have your blood drawn up to two to three times a week post transplant, with the results to be reviewed by your medical team. This frequency will eventually decrease the longer you have had your transplant. Within the first couple of months, you may have a clinic appointment at least once a week at the Transplant Clinic so that your medical team may visually inspect your progress. Skin biopsies will be done in the clinic at pre-scheduled post-op days and with any possible rejection episodes. Other tests will include a functional MRI, vascular ultrasound, and angiography.

You will need to maintain appointments with your primary care physician, or any other specialist you were seeing prior to transplant, to keep up with your general health. This also includes receiving the flu shot each year and routine cancer screenings. Most importantly, you will need to keep your appointments with Occupational Therapy for intensive hand therapy to ensure your new hand achieves maximal function and sensation.

Resuming activities after transplant

Anxious to resume activities following transplant, many patients inquire about the timeline for their recovery. Depending on your level of amputation, these achieved goals may occur within different time frames, however it is most important that you stay engaged in your hand therapy and maintain your immunosuppressive drug regimen.
Diet and Nutrition: Caffeine should be restricted to prevent vasoconstriction. You should follow a proper, well-balanced diet (low-fat, low-cholesterol) after transplant to maintain a healthy weight. If you have or develop high blood pressure, you may be asked to follow a low-sodium diet. A high potassium level may also occur after transplant as a side effect of your medication. You may be asked to limit your potassium intake during that time, until your drug level reaches a therapeutic level in your body.

Exercise and Weight Management: Light exercise is recommended immediately post transplant, with consideration to your newly transplanted limb. It is important to maintain a healthy weight for your overall health.

Sun Exposure: Because transplant recipients are more likely to develop skin cancer, we recommend that all patients guard their skin from the sun. This involves always wearing clothing that protects the skin from sun exposure (including a brimmed hat) and sunscreen on all exposed areas.

Being in Crowds: Because transplant patients are taking medications that suppress their immune system, the concern about catching colds and other infections is real. However, we want our patients to enjoy their new life. The Transplant Team does not recommend avoiding all crowds. Common sense works well here. If someone close to you is sick, keep your distance and maintain hand hygiene.

Sexual Activity: Sexual activity may resume shortly after transplant, however it is important to use birth control and practice safe sex, especially within the first year post transplant, to avoid conception while on high doses of medication, which could cause harm to a fetus.

Hand Function and Sensation: The ultimate goal of hand transplantation is to make one feel whole again. Sensory and motor function may be achieved at different intervals, however within one year post transplantation, you can expect to regain the sensation of temperature, pain, and light touch as well as the ability to grip and pinch with your new fingers. The more you use your transplanted limb, the stronger it will become, leading to an overall improvement in the quality of your life.

We want potential hand transplant recipients to make an informed decision about transplant that is right for them. Evaluate your options. Consider the facts and ask questions. Then, choose the program based on the best chance of success, expertise, convenience, and personalized care.

A big difference you will find with UT Southwestern’s Hand Transplant program is the commitment to provide you and your family with outstanding, individual attention and care. We are an IRB approved hand transplant program, an important aspect within this field. This ensures the medical and ethical integrity of the program. Our philosophy is that hand transplantation is not an isolated surgical procedure, but part of a continuum of medical care for the amputee population. To best prepare yourself for transplant, know what to expect both before and after the surgery. Most importantly, we are here to educate you and to support you in this life-changing decision.
References: