

Know Your Options

An Explanation of the Rotationplasty and Tibia Turn-Up Procedures

by Kevin Carroll, MS, CP, FAAOP

People who have been diagnosed with cancer and are faced with the impending amputation of a leg find themselves in a state of shock and grief. Parents of children who are born with a lower-limb difference experience similar emotions. Under these circumstances, it is difficult to talk openly with a surgeon about amputation and to meet with a prosthetist to discuss future prosthetic needs. The fact that the majority of these patients are children, teen-agers and young adults only increases the level of anxiety. Yet beneath the surface of these painful conversations are seeds of hope: Amputation can save a person's life, preoperative consultations can help people make better decisions, and children who are fitted early with a prosthesis can lead very active lives.

Knowing what the options are before surgery can enable patients and families to make the best choice for their specific situation. Not all surgeons are aware of limb-sparing procedures, some of which involve bone replacement with human or lab-grown bone, or prosthetic implants. Some surgeons may make what they consider the most "conservative" recommendation: a standard above-knee amputation at a point significantly higher than the site of the cancer. To be as informed as possible, the best course of action is to consult with one or more orthopedic oncologists at a comprehensive cancer center. Parents of children with congenital lower-limb differences should seek the advice of a pediatric orthopedic physician. These conditions require highly specialized physicians and medical facilities.

Before having an above-knee amputation or a surgical fusion of the knee, patients should learn about the Van Nes rotationplasty and the tibia turn-up, two surgical procedures that may increase their mobility as prosthesis users. At first glance, both procedures appear somewhat extreme and are difficult for people to visualize. However, the long-term positive results experienced by most patients are impressive. Ideally, rotationplasty gives patients a level of function that may be equivalent to a below-knee prosthesis user, even though they have experienced an above-knee amputation. The goal of tibia turn-up is to provide the person who faces a high-level, above-knee amputation with a longer, stronger residual limb for the prosthetic socket to lock onto.

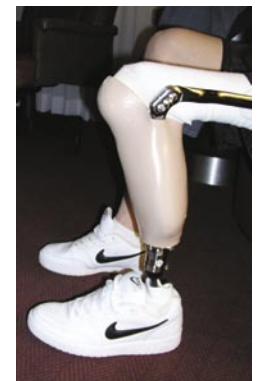
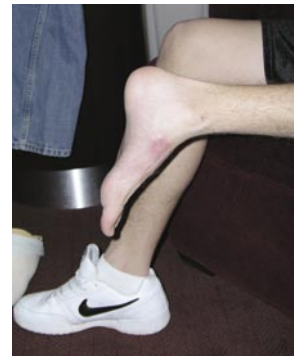
These procedures are generally not an option in cases of traumatic injury that requires amputation although there may be isolated situations where this approach should be considered.

Rotationplasty

Applied in cases of osteosarcoma and congenital lower-limb differences, rotationplasty involves a partial amputation of the leg above the knee. The lower leg and foot are rotated 180



degrees, the length is adjusted, and the tibia is then fused to the proximal femur. The foot is positioned where the knee used to be, with the heel portion in front and the toes pointing back. The ankle now functions in place of the knee joint. Although it is rare in the United States,

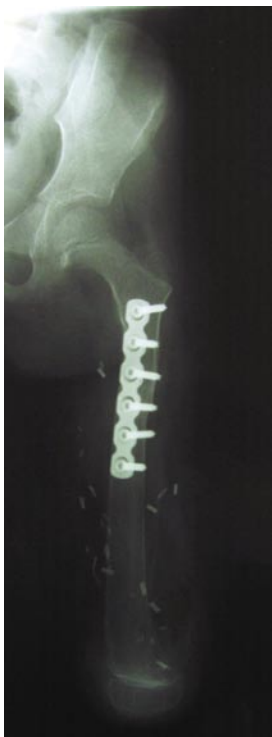


rotationplasty is a widely accepted procedure in Canada, where Dr. Van Nes introduced the surgery in 1950 for children with congenital limb differences.

The primary reason for rotationplasty is to enhance the person's mobility as a prosthesis user. Placing the ankle joint in the position of the knee creates a functional,

natural knee, and the toes provide important sensory feedback to the brain.

The appearance of the limb following rotationplasty is very unusual and is a concern for many people from both a cosmetic and a psychological standpoint. Patients and their families who are considering rotationplasty should talk with other people who have had the procedure and are now prosthesis users. For many, the functional advantages quickly outweigh their concerns about appearance. Children and young adults have a lifetime in front of them, and the increased mobility and freedom that may follow rotationplasty can be a significant improvement over the use of a traditional above-knee prosthesis.



X-ray of a tibia turn-up

end of the tibia to be fused to the bottom of the femur. The muscles are then sutured back onto the tibia.

Tibia turn-up is an alternative that people may consider when the appearance of a rotationplasty – a backward foot at the knee position – seems too extreme. Tibia turn-up is also an option when cancer occurs in the thigh, requiring a short above-knee amputation. By having their

tibia fused to their femur, these individuals now have a long residual limb that will be easier to fit with a prosthesis and that will provide them with increased function. Although these patients will wear an above-knee prosthesis with a mechanical knee, their comfort and mobility will usually exceed that of above-knee prosthesis users with a short residual limb.

Managing Growth

Rotationplasty and tibia turn-up techniques both make allowances for the natural process of growth that extends into young adulthood. Before surgery, x-rays and other tests are performed to determine how much growth will occur in the sound leg. Growth plates at the hip account for 30 percent of growth in the femur while plates at the knee contribute the remaining 70 percent. In the lower leg, plates at the ankle account for 40 percent of growth in the tibia and fibula, while those at the knee contribute the remaining 60 percent. Therefore, if the growth plates on either side of the knee are completely removed during amputation, the surgeon may choose to make the residual limb a little longer to compensate. Oftentimes, however, a growth plate can be salvaged, enabling the femur to grow naturally. If, in the future, the amputated side begins to grow more than desired, the surgeon can stop the growth by suturing the growth plate.

Proximal Femoral Focal Deficiency

Rotationplasty can be performed on children with proximal femoral focal deficiency (PFFD). With PFFD, the child usually has one leg that is fully developed and one leg that has a very short femur. The result is a leg that can be up to half the length of the sound leg, with the anatomical knee close to where the hip joint should be and the anatomical foot close to where the knee joint should be. For many years, the most common treatment for PFFD was to amputate at the ankle (Syme's operation) and then fit the child with an above-knee prosthesis. As an alternative, rotationplasty surgery involves rotating the limb 180 degrees. The ankle now functions as the knee

joint, and the anatomical knee above the rotationplasty is fused to provide a stable tibiofemoral lever arm that functions as a thigh.

There have been further modifications of the rotationplasty technique for people with PFFD, including an operation that involves a higher-level amputation of the limb above the anatomical knee. The limb is rotated 180 degrees, and the anatomical knee is left unfused to function as the hip joint while the ankle functions as the knee joint. Some surgeons favor this type of rotationplasty while others may consider it too extreme.

When consulted on cases of PFFD, I consider all of the options, including the traditional approach of a Syme's amputation. I have seen people do well with both the Syme's approach and with rotationplasty. (The tibia turn-up technique is not an option in cases of PFFD.)

The Prosthesis

As with any prosthesis, the fit of the socket is critical. Finding a prosthetist with experience casting a rotationplasty



socket may prove challenging. However, with practice, it is no more difficult to cast a rotationplasty socket than any other type of socket. The socket should encase the foot and should have a soft inner liner and an outer layer fabricated from a more



rigid plastic. Hinges are placed on both sides of the ankle joint (now positioned as the knee) and then attached to a corset that extends up around

the thigh; Velcro straps hold the corset in place.

The socket for a tibia turn-up prosthesis should be a dynamic above-knee design. With both tibia turn-up and rotationplasty, the top edge of the socket must extend above the point where the bone has been fused. The knee on the amputated side may stick out a little farther than the natural knee when the person

sits down. For most users, this is a small concession to make in exchange for a smooth gait, usually with no discernible limp. As mentioned, suturing the growth plate can stop excessive growth.

In cases of PFFD, the child is fitted with a type of below-knee prosthesis with a corset that extends up to the hip to increase control when walking. Generally, it is believed that children have better mobility using a below-knee type prosthesis after rotationplasty.

An intensive physical therapy program is one of the keys to adapting to a rotationplasty or tibia turn-up prosthesis. With rotationplasty, it is critical to develop good range of motion in the ankle joint, which is now functioning as a knee. People should seek out a prosthetist and a physical therapist who will develop a strong interest in their individual situation. The prosthesis itself will undergo many minor adjustments by the prosthetist as the patient progresses through physical therapy.

Hope for Active Lives

When faced with realities such as cancer, chemotherapy, amputation, and congenital limb differences, patients and their families are doing well just to move from one day to the next. In the midst of anger, grief and loss, they are asked to take part in extremely difficult conversations and make major decisions that will last a lifetime. Consulting with experts provides patients and families with critical information, support and resources. Options like rotationplasty and tibia turn-up, although unusual, may enable people to live fuller, more active lives as prosthesis users. It is in working together that patients, families, physicians, prosthetists and therapists can create hope for better long-term outcomes. ■

Additional Resources

American Cancer Society News Center. "Alternative surgery gives cancer patient a second chance." 11/19/2001. www.cancer.org

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Hillmann A, et al. "Electromyographic and gait analysis of forty-three patients after rotationplasty." *The Journal of Bone & Joint Surgery*. 2000; 82:187-196.

Krajbich, I. "Function in children with Van Nes rotationplasty." (Video presentation). *Journal of the Association of Children's Prosthetic-Orthotic Clinics*. 1990; 25:2; 28.

Kritter, AE. "Tibial rotation-plasty for proximal femoral focal deficiency." *The Journal of Bone & Joint Surgery*. 1977; 59: 927-934.

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About the Author

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