



Notes From the Medical Director

Prosthetic Rehabilitation and Technology *Options and Advances for Seniors*

by Douglas G. Smith, MD

"To know how to grow old is the masterwork of wisdom and one of the most difficult chapters in the great art of living," said Henri Frederic Amiel, the 19th century Swiss philosopher and poet. The diseases and disabilities that disproportionately try to rob seniors of their independence and joy in life certainly make this chapter of their lives more difficult. Unfortunately, most amputations in this country are also performed on older people for causes related to diabetes and severe peripheral vascular disease. Fortunately, while managing and overcoming these problems is a great challenge, prosthetic rehabilitation and technology can help restore independence and should, therefore, certainly be available for seniors – perhaps the people in our society who need them the most.

The Extent of the Problem

Statistics tell us that the majority of people in the United States who require an amputation are age 65 and older. Moreover, the deadly diseases of diabetes, obesity and severe peripheral vascular disease – all



of which can lead to amputations – are increasing at horrifying rates as the overall population ages. The following numbers, provided by the Amputee Coalition of America, illustrate the extent of limb loss in the U.S.:

- More than 1.6 million people in the U.S. have some type of limb loss, excluding fingers and toes.
- More than 185,000 amputations are performed annually in this country.
- The prevalence rate is highest among people age 65 and older (19.4 per 1,000).
- 18.2 million Americans have diabetes, and 41 million have prediabetes.
- More than half of amputations performed on people age 50 and older are due to diabetes or peripheral vascular disease. A study at Johns Hopkins University showed that there are about 86,000 diabetes-related amputations performed in the U.S. each year.

To make matters worse, it generally takes older individuals longer to achieve wound healing, regain strength, and navigate the rehabilitation process following an amputation. Simply put, it's harder to heal when you're 70 than when you're 17. In addition, during the downtime between an infection, an ulcer, or gangrene and the time when prosthetic rehabilitation begins, older people are more prone to becoming deconditioned (a state in which they lose energy, muscle strength, and motivation). Generally, the greater the age, the greater the impact deconditioning will have on successful rehabilitation.

Not only do wounds heal more slowly, conditions such as existing heart and lung problems often become worse around the time of surgery and hospitalization and dramatically decrease strength and energy reserves. On the musculoskeletal side, reflexes slow, joints become stiff, and muscles become weaker. Unfortunately, all of these factors can make prosthetic rehabilitation from amputation difficult. But while rehab is certainly more challenging for individuals in their golden years, it is also extraordinarily worthwhile. My personal goal is, therefore, to work very hard with every older amputee to return him or her as close as possible to his or her preamputation lifestyle. I certainly agree with the philosopher Francis Bacon, Sr., who said, "Old wood best to burn, old

wine to drink, old friends to trust and old authors to read."

Preprosthetic Rehabilitation

Learning to transfer safely is absolutely the most important initial goal for anyone who has a lower-limb amputation. As a young orthopedist, I used to believe that the ability to walk was the main factor giving people independence. However, time, experience and knowledge gained from meeting and working with people with limb loss has taught me that the ability to transfer is the key ingredient to self-sufficiency and independent living.



Success with this first goal of rehabilitation means regaining the ability to transfer independently in and out of bed, on and off the toilet, and in and out of the shower or bathtub. Transfer training should begin the first day after surgery. Working on the strength and skills to transfer independently needs to happen well before the new amputation site is healed enough to even consider a prosthesis.

In addition to transfer training, a set of skills known as Activities of Daily Living (ADLs) must be incorporated very early into the recovery process. ADLs include personal hygiene, dressing, eating and bathroom skills.

After mastering transfers and ADLs, the next skills to work on include tasks to manage and maintain your personal space and possessions. These are skills that people must try to re-master whether or not they ever advance to prosthetic rehabilitation. I've seen many people mistakenly put off re-learning these vital skills until they have their prosthetic leg or arm. Waiting, I believe, is a mistake.

Factors in Prosthetic Rehabilitation

When it comes to degree of difficulty in

rehabilitation, there's a significant difference between those people who have amputations in the foot, ankle and below the knee and those people with higher-level amputations at the knee, above the knee and in the hip area. The difference is a mechanical one; those people in the first category still have a knee joint with strength and muscle power, while those in the second category do not.

Certainly, the degree of difficulty in learning to use a prosthesis and walk following an amputation increases as the amputation level moves higher. A person who receives an amputation below the knee or in the ankle or foot is generally encouraged to begin immediate or very early postoperative prosthetic training. However, those who have amputations at or above the knee or in the hip or pelvis usually find recovery and rehabilitation far more challenging. One of my patients whose below-knee (transtibial) amputation was revised to an above-knee (transfemoral) amputation told me, "Doc, you said this transfemoral rehab would be 10 times harder than it was for my transtibial amputation. It's more like a hundred times harder!"

With the partial foot, ankle level and transtibial amputations, we are generally very aggressive about getting the person a prosthesis as soon as possible because a prosthesis at this level helps with transfers, balance, and going from sitting to standing. The challenges increase with higher-level amputations, such as a knee disarticulation, transfemoral amputation and hip disarticulation mainly because of the loss of knee power. The knee is amazingly strong, and its strength is vital for walking, rising, sitting and transfers. After an amputation at or above the knee, the muscles around the hip can move the residual limb forward and back, but the strength the knee gives us for lifting and support is gone. A prosthesis for higher-level amputations simply does not help with transfers because currently available prosthetic knees do not have motors to replace the muscles.

Test your own knee power: Sit in a chair. Stand up. Sit back down. Now, raise one foot off the floor and try to lift yourself out of the chair using the other leg. Most people can't do this without using their arms to push themselves up. And once standing, you have to bear all of your weight on one leg, which greatly affects balance. You can see what a big difference

having the power of both knees makes.

Before a person with an amputation at the knee or higher is fitted with a prosthesis, we strongly emphasize the need to master "The Three Vital Skills." These are:

1. Transferring in and out of bed independently
2. Going from sitting to standing independently
3. Walking in parallel bars or with a walker for at least 25 feet.

A common misconception is that a prosthetic knee, especially one of the newer high-tech models with microprocessors, will give back the person's knee power. I wish this were true. Unfortunately, even with technological advancements, a prosthetic knee that can help a person get from standing to sitting like a real knee is not yet commercially available. The future does indeed hold promise, and I have seen prototypes of these knee units with motors and power to assist in sitting, standing and going up stairs. This technology is, however, currently in experimental use and under testing.

Changing Views on Technology

In the past, high-tech prosthetic devices were primarily targeted toward the youngest and most active individuals with limb loss. This practice came about because many of the early high-tech devices, such as energy-storing prosthetic feet, were initially designed so that people could run. When the goal was running, it certainly made sense to think about technology for those who were at the highest end of the activity spectrum.

But our views on technology and its applications are slowly changing. In fact, much of the newer technology, especially that involving knee units and, to some degree, other components such as shock-absorbing pylons, is designed to reduce stress to the skeleton, increase stability, and minimize the chance that the prosthesis will buckle and the person will fall. The newer technology may, therefore, pay the biggest dividends for those who struggle in using their prosthesis to stand and to walk. For these people, running is not even on their current list of goals. I have many patients who are elderly and have walking limitations who have told me that they have gained increased confidence using such higher-tech devices.

They tell me that there's less jolting and jarring to their hips and back and that their microprocessor knees provide increased protection against stumbling and falling.

Interestingly, they also tell me that they do not have to concentrate and expend as much mental energy for walking. "Mental energy?" For most individuals, walking is automatic. It doesn't require a lot of thought. But a person with an amputation at or above the knee must think more about walking, especially on uneven surfaces or unfamiliar terrain. "How slippery is the ground? How steep is that hill? Is that dirt very loose, or will it provide good traction?" And walking in crowds where other people are is risky. "Will my technology allow me to adjust and adapt when the person walking in front of me stops suddenly or someone cuts unexpectedly across my path?" We make countless adjustments to our stride every time we walk. The right technology for the right person frees him or her to let more of the walking come automatically.

While many of my older patients say the new technology is beneficial, its exact benefits are very difficult to document in research studies. The concepts of stability, stumbling, concentration and mental energy are simply not easy to measure. This makes it incredibly difficult to convince insurance companies and the agencies that pay for prosthetic devices of the cost-effectiveness of these added benefits. A payer may, therefore, argue that high-tech devices are best for the youngest, most active users, who generally come from the age groups that least frequently have amputations. I disagree. I believe that the advanced technology is of great benefit to older users. Unfortunately, since they make up the largest group of amputees and prosthesis users, this tends to make the payers cringe.

The purpose of prosthetic technology should not only be to help someone run faster. Advanced technology can also benefit those people who are 60 and older who simply want to move around safely and comfortably. High-tech solutions may enable them to do their own shopping, cleaning and cooking. "But is it cost-effective?" someone might ask. I would think that paying more for higher-tech prosthetic devices to allow independent living for older people would have to be less expensive than paying for assisted living, especially over many years.

It's very ironic that advances in prosthetic technology are treated differently from other healthcare advances. Technological advances in wound healing, for example, are not reserved only for the youngest in society. In fact, advanced wound healing agents are frequently geared to those who have the most trouble with wound healing – often elderly individuals. Likewise, advanced dialysis technology for those with kidney trouble or advanced technology to help with heart function, such as advanced pacemakers and cardiac stimulators, is certainly not reserved only for children and young adults. Why do we look at prosthetic technology differently? Technology can have a big impact on anyone struggling with disease or mobility issues.

My hope is that everyone with limb loss can be provided the most appropriate prosthetic device. As new technology comes out, I hope that we will not make the mistake of reserving it only for the youngest and strongest. Advanced technology may truly help older individuals return to the activity level they enjoyed before their amputation, minimize stumbles and falls, and increase their confidence so that they can return to their life and begin to enjoy it again. ■

"The oldest trees often bear the sweetest fruit."

– German proverb