



Healthy Living for Amputees: Addressing the Physical Realities of a Lower Limb Amputation

The one thing that we know as amputees is that our amputation(s) has an effect on all areas of our lives. In this document, we highlight many of the *physical* ways amputation impacts our lives and present some solutions to help deal with these realities. The following list is not an exhaustive one, but it does cover many key areas:

- Energy Expenditure
- Gait of the Leg Amputee
- Overuse or Repetitive Strain Injuries
- The Importance of Weight Control
- The Importance of Physical Exercise
- Perspiration – No Sweat!
- Caring for Your Residual Limb – Skin Care and Hygiene
- Pain and Phantom Limbs
- Back Concerns and Care

Not all these issues will impact the lives of all amputees. Some may never be an issue for you. It is our goal here to ensure you are well informed of all the issues in order to be able to live as healthy, productive, and limitless life as possible.



Energy Expenditure

Leg amputees use more energy to walk the same distance that non-amputees do. Amputees have a higher level of oxygen consumption. *Physical Therapy Management of Lower Extremity Amputations* by Gertrude Mensch and Patricia M. Ellis refer to a study showing an increase in oxygen consumption for:

- Below knee amputees from 9% to 20%
- Above knee amputees from 45% to 70%
- Bilateral above knee amputees up to 300%

Therefore, one can generally say that the higher the level of amputation, the more energy used during walking. Amputees who need more oxygen to walk will get out of breath more quickly than non-amputees, and they will often adjust their walking speeds to their capacity for energy expenditure (i.e., they will slow down).

Other studies indicate similar results. In "Prosthetic and Orthotic Care for the Elderly," in *Alignment 2006* (publication of the Canadian Association for Prosthetics and Orthotics), Dr. Meridith Marks writes: "There is approximately a 30 per cent increase in energy demand for a transtibial amputee

and up to 90 per cent increase in energy demand for a transfemoral amputee to walk a set distance (Waters 1992). What is often forgotten is that these same patients automatically slow their speed of walking to maintain their per minute energy requirements at a near normal level.”

Also, *Rehabilitation Management of Amputees* (edited by Sikhar Nath Banerjee) indicates that leg amputees have trouble keeping up with peers when walking because they generally walk more slowly than individuals without amputations. Some studies indicate that a comfortable walking speed for below knee amputees is about 22 per cent slower than for individuals without amputations. Therefore, to keep pace with non-amputees when walking, the amputee will use more energy to walk faster. It is clear why amputees, with all other factors being equal, tire more quickly than non-amputees when walking.

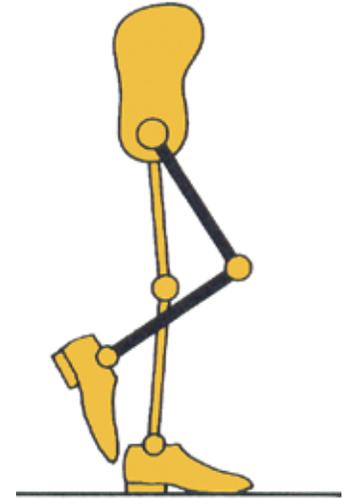
Rehabilitation Management of Amputees also points out that amputees will use more energy going up *and* down slopes – a ten per cent upward slope doubles the energy required as compared to that needed walking on level ground, and a 20-25 per cent slope triples that energy. On downward slopes, the leg amputee uses ten per cent more energy descending on low grade slopes and that percentage increases with steeper down grades.

Extra weight carried on the body of the amputee or through the artificial limb, such as the weight of heavy winter footwear, increases the amount of energy the amputee uses when walking. For example, an increase of 2½ lb. of shoe weight increases energy use by five to ten per cent; soft or uneven ground increases energy demands by 40 per cent or more; climbing stairs greatly increases energy use, and even descending stairs increases energy use by about one-third.

Simply put, amputees use more energy to walk. Energy efficient prosthetic feet and knees are designed to help alleviate some of this extra energy expenditure. Still, because amputees have higher energy demands, it is clear why a healthy diet and regular exercise are so important.

Gait of the Leg Amputee

Gait is a person's manner of walking. In *Physical Therapy Management of Lower Extremity Amputations* by Gertrude Mensch and Patricia M. Ellis, it is indicated that about 40 per cent of a person's gait cycle is when the leg is in swing phase or when the foot is off the floor and swinging through, while about 60 per cent of the gait cycle is in stance phase when the foot is in contact with the floor or ground.



Why is it so very important to walk well – to have a good gait? Walking well actually minimizes the additional stresses put on the body. With a poor gait (e.g., limp), the amputee puts stress on the residual limb, the sound limb, other body parts like the trunk and back, and ends up using more energy to walk because he/she has to work harder to bring the body back into balance and alignment.

Admittedly, when you are a new amputee, it seems like it takes much more effort to walk properly. You just want to walk, even if that means with a poor gait. However, learning to walk properly will result in a more energy efficient gait down the road. A lack of proper training and practice on the amputee's part may result in the amputee developing poor walking habits which are difficult to break.

A few examples of common amputee gait problems include:

Stiff-legged walking – caused by amputees with short residual limbs keeping the knee stiff due to poor leverage or a fear of falling.

Abducted gait – the prosthetic leg is swung out to the side of the body, it may be caused by poor balance, pinching of the residual limb by the inside socket brim or fear of the prosthetic knee buckling.

Hip hiking – keeping the prosthetic knee stiff and hiking up on the toes of the sound foot to ensure the prosthetic foot clears the ground, it may be caused by an inability to manage the weight of the prosthesis, not using the knee properly, unequal step lengths, or problems like osteoarthritis of the hip.

Uneven step length – caused when amputees take a longer step with the prosthesis than the sound limb resulting in less time bearing weight on the prosthesis, it may be caused from lack of perception, fear of falling or residual limb pain.

The article “Understanding Gait Deviations” in *O&P Business News* (December 15, 2006) states: “Many lower limb amputees take on pathological gait patterns where certain movement deviations substitute for those that the amputee cannot perform. Jacqueline Perry, MD, said in her book *Gait Analysis: Normal and Pathological Function*, these compensations cause energy cost to increase and often compromise function.”

To walk well, the amputee must have a comfortably fitting socket, a properly aligned artificial leg, and proper training. Consulting a physiotherapist who has worked with amputees to develop a proper training program is important. Using a mirror at home to watch themselves walk, or videotaping themselves, allows amputees to see how well they are doing. Exercise is important generally, and specific exercises can help build up the muscles used in operating an artificial leg.

Overuse or Repetitive Strain Injuries

Lower limb amputees have to compensate for their missing limb, even if they wear a prosthesis. This means the sound limb takes more wear and tear, called *chronic higher loading*. Some studies indicate that chronic higher loading through the prosthesis may increase the risk of degenerative joint disease. A 1978 study, *Bone and Joint Changes in Lower Limb Amputees*, indicated increases in osteoarthritis, back pain, scoliosis and osteoporosis; and a 1994 study *Osteoarthritis and Elderly Amputee Gait* (Drs. Ed Lemaire and Ronald Fisher) of below

knee amputees concluded that “based on clinical and biomechanical results, long-term transtibial prosthetic users can be considered to have an increased risk for developing OA (osteoarthritis).”

With that in mind, it is an important issue for amputees to consider, even at a young age. Though we cannot expect very young children to understand the impact decades down the road of what they do or do not do now, all amputees need to be encouraged to simply take care of their bodies. Healthy living – that is, eating well and physical exercise – is the first step to preventing any possible future conditions. Another very positive point is that improvements in prosthetic components will continue to provide energy return, shock absorption, and more natural function which will all aid in alleviating potential problems for amputees.

A research update, “Difference in Leg Lengths Could Indicate Pattern for Osteoarthritis,” in *O&P Business News* (January 1, 2007) states that “a leg length difference of as little as two cm is associated with knee and hip osteoarthritis.” Though the research did not refer to unequal leg lengths specific to wearing a prosthesis, the correlation to prosthesis wear is clear. Prosthetists understand how crucial leg length equality is and that is why they are so careful in checking for it during the prosthetic fitting.

Another important point for lower limb amputees to remember is to wear your prosthesis or use a mobility aid as much as possible. Limit hopping on your sound leg as it can lead to injury from overuse or by stubbing your toes or falling.

In *Reintegration and Adjustment As Seen by the Amputee*, Cliff Chadderton sums it up like this:

“A long time study of these problems by The War Amps indicates that while the development of such after-effects is inevitable, it can be slowed, and possibly the effect can be lessened, if the amputee, and those responsible for his/her care, will take necessary precautions to ensure he/she has a properly fitting prosthesis [and] it goes without saying that if the amputee can initiate and maintain a program of physical exercise, designed to develop

the non-amputated part of the body and the inter-related muscles, ligaments and tendons, the incapacity of such sequelae can be minimized.”

The Importance of Weight Control

In determining the appropriate weight goal for an amputee, usual weight-to-height ratios do not apply because an artificial limb actually weighs less than a human limb. Besides the simple fact that it is overall a good health practice, maintaining a healthy weight is of additional importance for amputees who wear prostheses. A change in weight of just five lb. can make an artificial limb uncomfortable to wear. A change in weight of ten lb. or even less can mean a new socket is needed. Doctors and dietitians agree that the best way to get to and maintain a healthy weight is to eat well-balanced meals and to exercise regularly.

The Importance of Physical Exercise

Everyone should get physical exercise, but why is it particularly important for amputees to exercise regularly? Simply put – because amputees use more energy in day-to-day activities and they need strong muscles to tolerate the weight of a prosthesis and to operate it.

“Chapter 32: Energy Expenditure of Walking” in the *Atlas of Amputations and Limb Deficiencies; Surgical, Prosthetic,*



and Rehabilitation Principles (Third Edition) states “Studies have shown that aerobic conditioning exercises both increase walking speed (by eight per cent) and decrease rate of oxygen consumption (by six to ten per cent) in subjects with transtibial and transfemoral amputations. Achieving and maintaining both cardiovascular fitness and muscle strength, therefore, are critical to the economy of walking and the long term functional status of individuals with lower limb amputations.”

Amputees need a combination of *strength* training and *cardio-vascular* training. Strength training builds up your muscles while cardio-vascular training helps you use oxygen better and improves your heart and lungs. There are countless programs, books and resources on exercise that can be applied to amputees. Amputees develop unique ways to take part in exercise programs or sports – working with therabands or weights is a good way to strength train, while activities like swimming, cycling, running or even walking provide good cardio-vascular training.

Perspiration – No Sweat!

Perspiration is the way the body controls its temperature. Doing any activity uses a certain amount of energy. This energy creates heat in the body. This heat escapes the body as perspiration. Once the body perspires, air circulates over the body cooling it and drying up the perspiration.

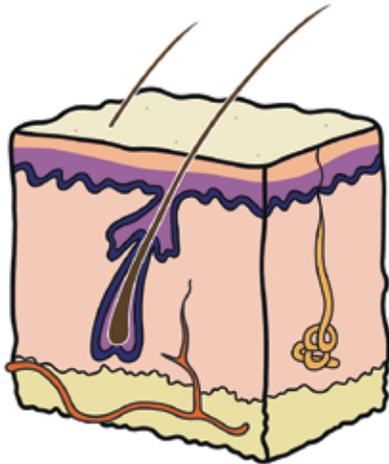
It is regularly observed that amputees seem to perspire more than people without amputations. The reasons for this are numerous:

- Amputees use more energy in many daily tasks – walking requires more effort and energy, and this increased energy generates increased heat that is released as perspiration.
- Amputees have less skin surface – skin partially controls body temperature as it is the means of perspiration leaving the body, and because the amputee has less skin surface, the remaining skin surface compensates by perspiring more. This is

particularly evident with amputees missing several limbs.

- The residual limb is enclosed in a prosthetic socket so the perspiration that results cannot get exposure to air to dry and evaporate so it rests in the socket against the skin.
- Sockets hinder the release of perspiration in the areas of your large sweat glands in the groin area.

Perspiration can lead to problems such as general discomfort, skin abrasions from pistoning inside a perspiration-soaked socket, bacteria growth, and odour.



There are steps amputees can take to limit and control the effects of perspiration (more on this under *Caring for Your Residual Limb – Skin Care and Hygiene*):

- Clean the residual limb and socket.
- Certain properties of residual limb or stump socks can help. The different types of fabrics that socks are made of provide different benefits. A few particular materials are: Silicones, which provide good cushioning of the residual limb and may help control perspiration; Coolmax fabric by Dupont, which provides a cooling effect by wicking the perspiration away from the skin (it's used in some socks by most prosthetic companies now); X-static material is made with a layer of pure silver which naturally inhibits the growth of bacteria. Whatever kind you use, using clean socks every day and even changing them during the day if necessary will help.

- Some amputees find removing the artificial limb part way through the day to clean the socket and residual limb helps prevent sores. This is because perspiration build-up in the socket causes the residual limb to piston in the socket leading to friction and thus sores.
- There are a large number of over-the-counter products that can be used to help control perspiration – some amputees use an antiperspirant on the residual limb – and some of the ones mentioned to us include: Secret Platinum, Pure & Natural Crystal Deodorant Stone, Drysol (a behind-the-counter product). Some products like AXE deodorant, Right Guard Extreme and Adidas spray or gel are preferred for their ease of handling. Dehydral is an antiperspirant/antibacterial cream. Some prosthetic companies have their own products to address this issue, such as the ALPS spray.
- For severe cases of hyperhidrosis (extreme perspiration), a Drionic unit may be used. It is an electronic device that gives small electrical shocks to the skin to close up perspiration ducts. Botox injections in problem areas may also be suggested, which will disrupt nerve signals to the sweat glands.

Products to specifically address odour associated with perspiration build-up in prosthetic sockets include:

- ProstheCare spray – by Cascade Orthopedic Supply, available through your prosthetic centre
- Benefect spray – by Sensible Life Products
- Xzuber cream – by JMG Products
- Natural Liquid body Powder (goes on as a lotion and dries as a powder) – by Trulife Limited, available through your prosthetic centre

Caring for Your Residual Limb – Skin Care and Hygiene

Occasional skin problems on the residual limb are a part of life for amputees who wear prosthetic devices. Skin problems can result for several reasons:

- Perspiration builds up in the socket which causes friction, and that friction leads to abrasions.
- Prosthetic sockets apply pressure that the skin was just not biologically designed to tolerate, so the pressure, friction and shear forces break down the skin.
- The moist, warm environment of a prosthetic socket is a perfect breeding ground for bacteria which cause skin problems.
- Sockets are made from plastics, resins, and other materials that might cause skin irritations or allergic reactions.

The skin usually fights bacteria through normal drying of perspiration by the air and from acids that the oil glands secrete. The normal drying action is prohibited when the residual limb is enclosed in an airless socket. Moisture gets trapped inside and some bacteria actually grow more rapidly in such moist environments.

Some problems amputees experience are edema (swelling), dermatitis, cysts, folliculitis, fungal infections, eczema, scars and ulcers.

There are many lotions and creams to address minor skin irritations and abrasions. Some simply help *moisturize and condition* the residual limb and protect it from irritation:

- Creams and lotions with vitamins A and E – available at your drugstore
- Uremol (with urea as the active ingredient) – available at your drugstore
- Wellskin Moisturizer – available at your drugstore

- ALPS Moisturizer or Prosthetic Ointment (with vitamins A and D) – by ALPS South Corporation, available through your prosthetic centre
- Easy Donn (with conditioners and essential oils) – by Cascade Orthopedic Supply, available through your prosthetic centre
- EDAP (only available through prosthetic centres) contains vitamins A, E and D; ADAPTSKIN, a product made by an amputee from his personal experience – by Adaptlabs



Many products have medicinal or antibiotic properties to help heal sores or abrasions. The first four bulleted items refer to over-the-counter products available at drugstores:

- Bactroban, Polysporin or Ozonol
- Products containing Aloe Vera
- Gold Bond medicated powder contains zinc oxide, talc, and menthol
- An antihistamine cream can relieve a pink rash that usually results from heat and moisture over the residual limb
- Products by prosthetic manufacturers such as Derma Repair by Otto Bock Healthcare – available through your prosthetic centre
- Prescription products (e.g., Lotriderm that contains the healing agent Betamethasone) – requires a doctor's prescription

Products that *protect* areas against friction and shield blisters or abrasions while they heal include:

- Mineral or baby oil around and under the edge of the liner – available at your drugstore

- Derma Prevent (a lubricant which dries on the skin to provide an invisible layer of protection) – by Otto Bock Healthcare, available through your prosthetic centre
- ALPS Skin Lotion (a silicone lubricant) – by ALPS South Corporation, available through your prosthetic centre
- ChafeZone (a stick product similar to a deodorant stick) – available through SportMeds Inc.
- Second Skin (medicated gel sheets which are covered by adhesive) – by Spenco®, available at drugstores or sporting goods stores
- OpSite and Cica-Care (gel sheets which are covered by adhesive) – by Smith+Nephew, available through your prosthetic centre

disposable wipes – available from your prosthetic centre.

- Wash at night preferably – this gives the residual limb and socket plenty of time to dry completely – any residual moisture that is not quite dry can cause tackiness between the socket and skin, and the resulting friction can cause abrasions.
- In the case of socket liners, having two will allow you to use one while the other is left to air dry for use the next day.
- Change stump socks daily and more often if the weather and perspiration issues warrant it.

For serious or persistent skin problems, it is important to always consult a doctor.

Taking care of your residual limb and socket of your artificial limb is a daily requirement for all amputees. As the saying goes – an ounce of prevention is worth a pound of cure.



Cleaning tips for the amputee's residual limb and socket:

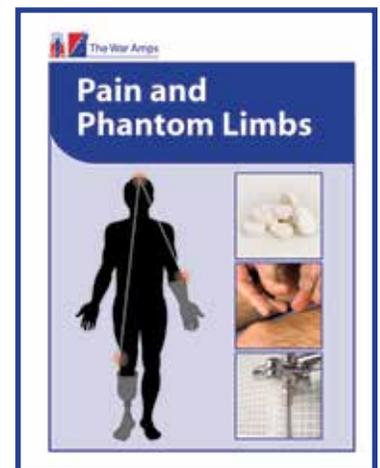
- Clean the residual limb thoroughly with mild soap and warm water daily; rinse well as a soapy film can irritate the skin. Some amputees like to use cleaning products like pHisoderm, Cetaphil, Spectro Derm – available at your drugstore.
- For the residual limb or prosthetic socket or liner, some prosthetic companies have their own products or cleaning systems, such as Otto Bock's Derma Skin Care, Ossur's Iceross Clean and Simple, or Centri's Cleani-Stump

The items mentioned in this section are simply many of the products amputees have told us they use. This is not an exhaustive list of what is or can be used by amputees.

Pain and Phantom Limbs

The reality of life for amputees, certainly for those who use a prosthesis, is that there will sometimes be pain. It may be felt as residual limb pain, phantom limb pain, back pain (see more below) and pain in the other remaining limb.

When it comes to the implications for amputees, much has been written on the topic of pain. We have compiled material into a booklet called *Pain and Phantom Limbs* which is available through the National Amputee Centre.



Back Concerns and Care

For the lower limb amputee, doctors generally keep a check on the spine to ensure problems like scoliosis do not result from deviations in gait patterns (e.g., limping by an above knee amputee). Maintaining strong back muscles will help prevent back problems associated with wearing an artificial leg.

It is imperative that the prosthetist regularly check the height of the artificial limb. Prosthetists are checking the limb's height when they place their hands on an amputee's hips to determine that they are level. Wearing a leg that is too long or too short can cause back problems that over time might worsen to the point where extensive therapy is needed to remedy them.

One hip disarticulation amputee shared how she has learned to manage the functional scoliosis that she developed. When she would sit, the socket of her hip disarticulation socket did not allow her to sit with her back in proper alignment. The misalignment went undetected for years causing her scoliosis to worsen. Working with her chiropractor, and using a simple lift device with her prosthesis when seated, has significantly improved her quality of life. Her goal in sharing her experience – which reflects the purpose of this whole paper – is to give amputees an idea of things to look for, so that we, as amputees, can have full healthy lives with the fewest complications possible.

More information on these topics and others can be found on
The War Amps website at waramps.ca
and/or by contacting the National Amputee Centre at
nac@waramps.ca or 1 877 622-2472.