The Implications of Amputees Being Overweight

by Jason T. Kahle, CPO, LPO, and M. Jason Highsmith, DPT, CP, FAAOP

The topic of a recent professional article was: "What advice do you give your amputee patients who need to lose weight?" The underlying theme was how carefully a prosthetist should approach this issue. Some insisted they would not mention the topic unless the patient brought it up first. We could not disagree more with this approach. We think that a prosthetist would be remiss if he or she did not address this issue with patients. Some amputees are under the regular care of a physician, and no doubt have been confronted with the fact that they need to lose weight. However, weight gain has specific effects that are unique to amputees. Understanding these implications is essential to make the most of your ability to walk as normally and efficiently as possible. And who better to address these issues with you than your prosthetist?

Over the last 20 years, obesity in the U.S. has risen to alarming levels. The Centers for Disease Control and Prevention (CDC) reports that 60 percent of Americans are overweight. The latest information from the National Center for Health Statistics shows that 30 percent of adults 20 years old or older are obese. That's over 60 million people! The average weight of American men is up to 191 pounds from 160 pounds in 1960. The average weight for women is now 164 pounds, up from 140 pounds. This weight gain trend has also established its presence in the amputee population. Unfortunately, the effects on a person with lower-limb loss are

even greater than for someone who is not an amputee.

Orthopedic problems like osteoarthritis have been linked to weight gain. When weight increases, stresses are multiplied exponentially at joint surfaces. This increased stress can lead to joints wearing out prematurely and an early onset of discomfort from degenerative changes associated with osteoarthritis. Joint replacement may be needed at younger ages in obese individuals. Wearing a prosthesis can place an unusual amount of stress on the joints, specifically the knee and the hip. These are already common sites for joint replacement. It can also place extra stress on the contralateral (opposite) side because many amputees favor their opposite side in standing, pivoting and stair climbing.

Cardiovascular issues for an amputee are also exponentially increased. Obesity causes increased cardiac demand as more tissue requires increased collateral circulation, all driven by the heart. Exercise is already more difficult in terms of energy expenditure for an amputee. Excess weight compounds the orthopedic and cardiovascular effects on an amputee. It has been shown that it is 40 to 100 percent more metabolically demanding to walk with transtibial (below-knee) amputation(s) and 90 to more than 200 percent more metabolically demanding to walk with transfemoral (above-knee) amputation(s). The already overtaxed cardiovascular system of a person with leg amputation doesn't need the additional burdens associated with obesity.

Component selection

All prosthetic feet and knees are manufactured and tested for breaking tolerance based on two parameters: activity level and weight. Approximately 150 versions of feet are currently available. If your weight exceeds 220 pounds, your choices are reduced by approximately half; your options are cut yet again by more than half if your weight exceeds 275 pounds. If your weight exceeds 300 pounds, you and your prosthetist only have about 10 feet to choose from. These are mostly very expensive because many of them are custom-made, and they are generally for higher activity levels. If you're an above-knee amputee, the scenario is the same with knees. Your choices become drastically limited. There are many great feet and knees on the market. But exceeding a healthy weight will dramatically reduce your choices and chances of using some of this great technology.

Socket fit

The socket (interface) is the most important part of any prosthesis. The socket provides you with control of the prosthesis, gait stability (the way you walk) and the weight-bearing characteristics (the support of your body weight that is loaded onto your residual limb). The most successful outcome of achieving these highly important principles is fitting someone with firm tissue consistency. This is because someone with firm muscle consistency is able to maintain better control, support and stability through a firmer foundation. It's like building a house on stone, compared to mud – the foundation is more solid. All of these elements affect the degree of comfort experienced by the user.

When someone is obese or even overweight, it's difficult to use the firm tissue that lies beneath the fatty tissue. The muscles can't provide a firm foundation because there is too much soft tissue buffering stable contact between the muscle and socket (Figure 1). Furthermore, it becomes impossible to use the bony anatomy for some prosthetic fitting techniques. For example, supracondylar suspension (a method of anchoring a prosthesis

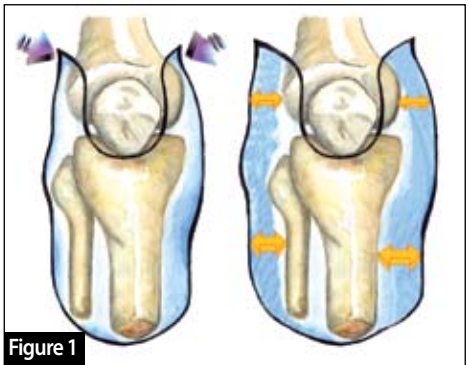


Figure 1

The transtibial socket on the left shows how the intimate relationship between the socket and the anatomy provides a "bony lock." The socket on the right shows that when someone is obese, there is more room between the socket and the anatomy, reducing support and stability.

by placing pressure above a joint) in transtibial prosthetics is contraindicated (inappropriate) for obese thighs, because extreme discomfort is likely with soft tissue compression and because this discomfort would hinder satisfactory suspension or control. In another example, ischial containment (socket cupping the lower pelvic bone) in transfemoral prosthetics is also difficult because excess adipose (fatty) tissue hinders one aspect of the bony lock needed to maintain pelvic control (Figure 2). These examples are extremely problematic

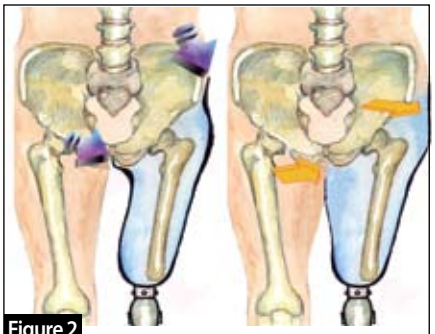


Figure 2

The transfemoral socket on the left shows how the intimate relationship between the socket and the anatomy will provide a "bony lock." The socket on the right shows that when someone is obese, there is more room between the socket and the anatomy. It also makes it extremely difficult to fit a transfemoral socket because of interference from the contralateral (opposite) side. This causes a loss of support and instability.

because bony "locks" are often critical elements to establish gait stability at the knee and/or pelvis. Instability at these joints not only will cause poor gait and problems with socket fit, but also can lead to damage of the joints.

Just as excess weight can limit choices in prosthetic feet and knees, options are also limited in socket design and suspension. A pin system is often the only choice, because suspension sleeves roll down and are difficult to don and doff properly for someone who is overweight. Cuff straps can't be used, again because of ill-defined bony anatomy. Furthermore, the socket must be thicker and therefore heavier. Many prosthetists like to use thermoplastics because they are easier to fabricate and to adjust, and they are less harmful to the health of technicians (Figure 3). But thermoplastics aren't a good long-term solution to the issue of high body mass; they're simply not as strong as thermosetting laminates. However, despite their increased material strength, laminations must also be thicker to withstand higher forces associated with high body mass. The recurring theme is that device mass is increased.

Figure 3

The socket on the left is thermoplastic. Prosthetists generally avoid fitting them on someone who weighs more than 200 lbs. This particular socket has a modification that will allow someone who is obese to reach down and release the pin. The sockets on the right are laminated. They can be made to support any weight, but they are more difficult to fabricate and adjust and they can be harmful to the health of technicians.

Won't losing weight cause socket fitting problems?

Yes, but the importance of losing weight, and keeping it off, far outweighs the inconvenience of having to go through the process of refitting a socket. Most prosthetists make prostheses with endoskeletal, modular components (interchangeable parts). Because of this, your prosthetist can change the socket, while you can keep your foot and knee (if you are an above-knee amputee). However, if you lose a significant amount of weight, your prosthetist may have to change your foot, based on a different category level. Hopefully, this weight change will be significant enough to allow your prosthetist to choose from a greater variety of feet (and/or other parts) that may benefit you more and increase your satisfaction and overall quality of life.

There are several steps that your prosthetist can take to help guide you through the process of losing weight.

1. Start with increasing sock ply; this is an inexpensive, quick and easy solution.
2. Use a thicker liner – e.g., if using a 3mm-thick liner, go to a 6mm liner, and then restart the sock process (Figure 4).
3. Pad the socket to compensate for volume loss (Figure 5).
4. Re-pull a thicker flexible interface to replace a thinner one, which will compensate for volume loss.

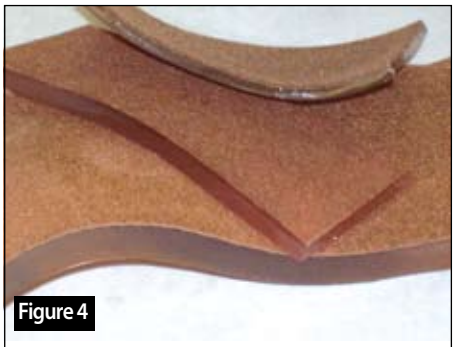


Figure 4

Various thicknesses of gel liners can be used as you lose weight. The more weight you lose, the thicker the liner that can be used to replace a thinner one.

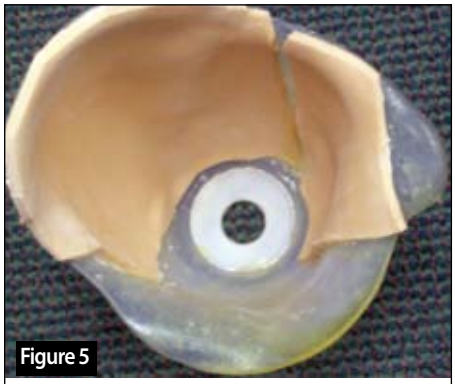


Figure 5

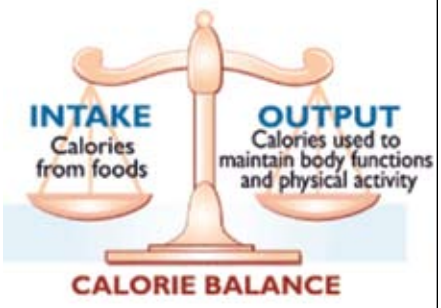
Sockets can be padded to compensate for volume (weight) loss until your volume has stabilized and a new socket can be made.

Physical activity

Physical activity is difficult. That's why it is fondly referred to as "working out." It's work! The easiest way to lose weight, in our opinion, is to watch your caloric intake. It's important to understand the relationship between the calories we take in through eating and drinking and the calories that leave us as a result of physical activity (Figure 6). There is no magic formula to reduce weight. It's simple – you must burn

Table 1

Premise: Calories Ingested + Activity Level (Calories Expended) = Change in Body Mass	
• Scenario 1	Calories In > Calories Expended = in Body Mass (Weight Gain)
• Scenario 2	Calories In < Calories Expended = in Body Mass (Weight Loss)
• Scenario 3	Calories In = Calories Expended = No Change in Body Mass



Courtesy of the CDC.

Figure 6

more calories than you take in. The scenarios in Table 1 illustrate the point.

A recent study estimates the average caloric intake of an American at 3,900 calories a day. No wonder there is a problem with obesity in this country, when the suggested amount is no more than 2,000- 2,500 calories a day. Before you go on a diet or change your health habits (to lose weight, initiate exercise, etc.), you should always consult your physician. There are many effective programs available, but, again, we recommend consulting with your physician to determine the best options for you. Another important consideration is that many amputees have other health problems (e.g., diabetes, hypertension or peripheral vascular disease) that may require special, medically supervised diets.

Other than dieting, the best way to expend more calories is to exercise. We know that it's difficult to exercise when you're an amputee, especially if you're already overweight or obese, but you have to start somewhere – otherwise, you will be destined to always battle the adverse effects of being overweight such as those discussed here. Many physical activities can be performed that don't require vigorous activity or high impact on your body and your residual limb. Examples of the impact of physical activity on calorie burning are listed in Table 2.

Limb loss inherently brings additional burdens on many fronts. Our intention here was to bring insight to the additional complications that being overweight or obese adds to lower-limb amputation and prosthetic wear. Furthermore, we wish to point out that physical activity brings satisfaction and enjoyment to many people, regardless of physical ability, skill level and body weight. Talk to your healthcare provider, set a goal, get a workout/exercise partner, and start changing your life one calorie, one step, one day at a time. ■

Credits: Figures and tables provided by Jason T. Kahle and M. Jason Highsmith

Table 2

Calories Expended (Burned) per Hour in Common Physical Activities

Physical Activity	Approximate Calories Burned per Hour for 154-lb. Person
Bicycling (<10 mph)	290
Bicycling (>10 mph)	590
Dancing	330
Golf (walking and carrying clubs)	330
Heavy Yard Work (chopping wood)	440
Hiking	370
Light Gardening/Yard Work	330
Stretching	180
Swimming (slow freestyle laps)	510
Walking (3.5 mph)	280
Walking (4.5 mph)	460
Weight Lifting (light workout)	220
Weight Lifting (vigorous effort)	440

Calories burned per hour will be higher for people who weigh more than 154 lbs and lower for people who weigh less. Source: CDC Web site, adapted from *Dietary Guidelines for Americans 2005*