Reprinted From: December 2012 | Vol. 10, No. 11

CASE IN POINT

Leading the Care Coordination Team with Knowledge, News and Learning

PROSTHETICS

# Lower Extremity Prosthetics: Proper Management, Uncomplicated Results

KEVIN S. GARRISON, C.P., L.P. AND GARY SAFF, MD

Lower extremity prosthetics are improving all the time. An amputee qualifying and participating in the Olympics is a true testament to this fact. These very complicated devices can now be provided with lighter weight yet stronger construction.

Electronic automatic vacuum suspension systems and microprocessor-controlled knees and ankles are now available as well. These advancements offer a natural ambulatory experience, especially for the bilateral amputee as never obtainable before. The relatively new prosthetic knee joint offers the amputee less thinking while standing, ambulating and sitting. It senses the absolute position of the foot and automatically tightens appropriately to prevent any loss of control or balance quite unsurprisingly. The electronic ankle actually lifts the toes of the prosthetic energy-storing foot.

This most natural automatic motion prevents us from catching the toe and falling as we walk. This ankle also automatically adjusts for different heel heights as the amputee casually chooses to change shoes. Angular changes required for ascending and descending ramps, unusual slopes and steps are easily accomplished within milliseconds. These microprocessor systems correctly offer reliable, smooth, controlled and confidence-building ambulation on the most challenging surfaces, offering another truly great advancement.

Upper extremity hands, wrists and elbows have advanced as well with similar electronic technology. Specifically, the hand has taken a leap forward with the availability of all-finger natural proportionally controlled motion. Seeing my veteran patient hold a water bottle with his new hand and then screw the top off and on with his existing hand, stating, “I can help my wife now with the baby bottles,” tells us just how important prosthetic care is.

## GAUGING PRESSURE POINTS

I would first like to explain what happens when an amputee lifts up their existing limb and puts all their body weight on the new residual limb. As you might guess, an enormous amount of pressure per square inch is forced on the remaining limb tissues. Knowing this, one can then begin to understand that as the residual limb may be of a shorter length, getting shorter as demonstrated by the different classified levels of amputation: very long, long, mid, short and very short, that as the limb is made shorter there rapidly becomes less peripheral weight bearing area to spread out the great pressures.

This impressive force must be properly disbursed through the prosthetic socket. The perfect fit will prevent pressure points that can lead to pain and eventual skin breakdown of varying degrees, even from abnormal gait patterns. This relates especially to the trans-tibial levels, as the trans-femoral levels are not as much at risk due to the different boney anatomy at this level.

## SEEKING THE PERFECT FIT

Creating the achievable “perfect fit” by the prosthetist is only possible through the use of sound biomechanical principals designed into the lower limb prosthesis. The use of diagnostic sockets made of high-strength plastic facilitates an ability to visually observe the illusive, important balance of pressure. With special tools the clear plastic can be precisely adjusted, adding or removing pressure anywhere within the socket. This enables the development of a properly balanced socket relative to the environmental needs of the residual limb. Biomechanical principals can also be tested as the patient ambulates on the clear check socket, thus ensuring they have been properly included in the entire socket design.

One example of proper biomechanics for the trans-tibial residual limb can be found in the relationship between the anterior patella tendon and the posterior proximal tibia. If the posterior wall is not high enough, the residual limb will not be held in an appropriate position while ambulating, which will prevent unwanted motion within the socket. The remaining limb will drift in a distal direction in short time causing undue pressure on the distal end resulting in pain. The tibia can also drift in an anterior direction repeatedly while ambulating causing anterior distal pain as well.

Another example of sound biomechanical principles being addressed in prosthetic design would be the use of proper suspension. Suspension is what keeps the prosthesis from falling off. Suspension is what keeps the prosthesis from slipping up and down causing unhealthy motion while ambulating. Suspension does directly affect the residual limb, balance, and ultimately comfort. The patients’ energy level is absolutely compromised as they actively struggle to try and use the improperly designed prosthesis allowing this unwanted and uncontrollable motion. Skin breakdown and pain will occur over time with this piston action. A high risk of falling can also develop if proper suspension is not maintained. The amputee should feel like the prosthesis moves with them, without any unwanted motion. This is proper suspension and it feels good.

Elevated vacuum (suction) suspension systems used today can actually eliminate all motion within the socket as weight is applied and removed during ambulation. The amputee truly feels one with the device, with a genuinely new level of comfort and control. These systems are said to relieve moisture within the socket as well, which is another healthy benefit for the amputee.

Now we have an excellent socket fit determined by the use of clear check socket fittings. Proper suspension has been determined through careful visual evaluation of the ambulating amputee and observing the skin, removing the prosthesis and looking for developing irritations. What else can cause pain through unwanted socket pressures? The answer is alignment. Where do we put the prosthetic foot under the amputee? Where do we put the prosthetic knee relative to the amputee, the prosthetic foot and ankle?

Without proper alignment the patient is at risk of falling, developing lower back pain, hip pain, knee pain within the sound limb and residual limb. How can this happen? One example is the prosthesis being short; this will strain the sound knee causing pain and contracture over time. If the prosthetic foot is positioned forward relative to the residual limb, the amputee will feel like they are walking up hill all day, wasting energy and contributing directly to residual limb pain. All other inappropriate alignment configurations will only compound the affects listed above.

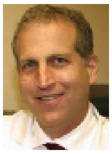
If not created with the greatest of care and consideration, the lower limb prosthesis can become a destructive force. Those that practice in pain management are well aware of how chronic pain syndromes, especially myofascial and spine-based, have their origins in a gait disturbance. Even slight pain and gait disturbance stemming from seemingly minor toe nail injuries and infections, to the more biomechanically unfavorable gait disturbance from chronic arthritic pain or a poorly fitted prosthesis, can result in the toll of chronic diffuse pain complaints if proper gait and biomechanics are not restored. Lumbar and cervical disk degeneration resulting in spinal stenosis, nerve impingement, scoliosis and chronic pain are an often unfortunate result.

Many chiropractic approaches to maintaining health and wellness are based upon this need for proper alignment. An attempt to treat the spine, without addressing the lower extremity issue, is often futile and frustrating both for the patient and clinician. An analogy often told to my patients is that you can't expect your car to drive smoother, no matter how many times you adjust your seat and steering wheel, unless that very important flat front tire is fixed.

Prosthetics, these very complicated devices when created properly, sincerely contribute to a restored active life for many patients. It is genuinely a gift to receive a proper device. The amputee should feel no pain while using their new prosthesis, only optimism.

---

Kevin S. Garrison C.P., L.P., the author of It's Just a Matter of Balance: You Can¹t Put a Straight Leg on a Crooked Man, is a certified and licensed prosthetist. Contact: kevinsgarrison@att.net



Gary Saff, MD, a licensed anesthesia pain interventionalist, independent medical examiner and acupuncturist at Integrated Pain Solutions of South Florida, is affiliated with Healthsouth Sunrise. Contact: saff@whatapain.com