Journal of Spine
ISSN: 2165-7939

Recio et al., J Spine 2014, 4:1
DOI: 10.4172/2165-7939.1000195

Case Report | Open Access

Transfemoral Amputation Following Chronic Spinal Cord Injury: A Prosthetic Solution for Improved Balance, Seating, Dynamic Function and Body Image

Albert C. Recio[1,2]*, Cara E. Felter[1], Allen Nicole C. Alana[3], Deborah A. Crane[4], Steven A. Stiens[4]

[1]*International Center for Spinal Cord Injury, Hugo W. Moser at Kennedy Krieger Institute, Baltimore, USA*
[2]*Department of Physical Medicine and Rehabilitation, Johns Hopkins University School of Medicine, Baltimore, USA*
[3]*Health Science Center, University of Tennessee, Memphis, USA*
[4]*Department of Spinal Cord Injury, University of Washington, VA Puget Sound Health Care System, Seattle, USA*

Abstract

Background: Advances in the care and rehabilitation of patients with spinal cord injuries (SCI) have resulted in extended survival. As SCI patients age, chronic lower extremity ischemic complications are resulting in amputations. The literature relating to lower extremity amputation and prosthesis in SCI patients is sparse. Limb amputation may cause weight distribution imbalances, leading to back pain and increased risk of pressure ulcer formation. Lower extremity amputation challenges skin management, sitting balance, functional range and body image.

Case Description and Methods: We report a systematic retrospective review of a disability adaptation equipment entrepreneur with T4 AIS B paraplegia patient who underwent right transfemoral amputation because of poor wound healing in the setting of severe peripheral vascular disease.

The prosthetic prescription included a total-contact socket with a knee-flexed formed prosthesis, mirroring the opposite limb. The socket design allowed decompression of the right ischium and secured the patient in the wheel chair for seated reach and leverage in work.

The patient consistently used the prosthesis over 10 years and recognized a variety of benefits including improved seating stability, functional reach, transfers, cosmesis, dressing options and body image, and documented increase in community activity.

Conclusion: Lower extremity prosthesis fitting for patients with SCI and amputation can improve posture, seating, transfers, static and dynamic balance, participation in functional activities, and community reintegration.

Clinical Significance: Active patients with paraplegia and new transfemoral amputation should be offered a trial of a prothesis to enhance mobility. Many of the medical and functional consequences of amputation after SCI can be prevented with careful prosthesis selection, prescription, and training patients in the use of lower extremity prosthesis.

Keywords: Spinal Cord Injury (SCI); Amputation; Prosthetic limbs; Body image

Background

Rehabilitation following Spinal Cord Injury (SCI) is a complex process involving physical, functional and psychological adaptations [1]. In order to achieve an active lifestyle, the person living with SCI must actively overcome limitations to his or her physical mobility with a combination of specialized equipment and techniques. Biopsychosocial theory assumes that individuals who have experienced SCI also are challenged with alteration of their body images. Furthermore, amputation after SCI causes further psychological stressors for persons who have already had to adapt their body image.

Amputation following SCI is a common complication due to the combined risks from neurogenic skin affected by changes in vasomotor function, and loss of protective sensation. Approximately 50% to 80% of persons with SCI will, at some time after their injury, develop a pressure ulcer [2]. The prevalence of pressure ulcers in populations with SCI has been measured at approximately 33% [3].

Unfortunately, these pressure ulcers can lead to tissue, bone, and joint infections. Other risks for persons with SCI include metabolic changes that occur as part of a constellation of secondary conditions. With aging, atherosclerosis progresses and has contributed to a current amputation rate that has doubled since 1975 [4]. The problem of atherosclerosis is compounded by the fact that critical limb ischemia is often undetected in those with SCI who have insensate lower extremities.

As Physiatrists we recognize that many of the impairments imparted by amputation can be ameliorated with custom prosthesis. Viewing the patient as interfacing with a complex environment we recognized the prosthesis could act as an adaptive innovation that will provide protection and enhance function [5]. We sought to highlight the advantages in a case report.

Case Report

We present the case of a 55-year-old man who sustained T4 AIS B paraplegia in a motor vehicle collision in 1991. His medical history included hyperlipidemia, neuropathic pain, and heterotopic ossification. His past surgical history was significant for T4 spinal decompression and laminectomy, spinal stabilization with Harrington

***Corresponding author:** Albert Recio, Johns Hopkins School of Medicine, Physical Medicine and Rehabilitation, 801 North Broadway 560, Baltimore, MD 21205, USA, Tel: 4439239227; E-mail: recio@kennedykrieger.org

Received October 22, 2013; **Accepted** December 20, 2014; **Published** December 22, 2014

Citation: Recio AC, Felter CE, Alana ANC, Crane DA, Stiens SA (2014) TTransfemoral Amputation Following Chronic Spinal Cord Injury: A Prosthetic Solution for Improved Balance, Seating, Dynamic Function and Body Image. J Spine 4: 195. doi:10.4172/2165-7939.1000195

rods from T1-T7. He is status post right hip disarticulation with flap closure. He underwent a left hip girdlestone procedure with transfemoral amputation due to spread of infection and ossification from the left to right hip.

His impairments include: impaired sensation below the level of his injury, decreased strength in key muscles associated with level of injury, decreased motor control, decreased functional skills, and poor seating balance and mobility. His mobility was further limited by his obesity having a BMI of 30. Two years after his amputation, the patient began seeking ways to improve his balance and cosmesis. The patient visualized right lower limb prosthesis and fashioned a prototype from bicycle shorts, plastic pads, and Styrofoam to create a flexed-knee foam limb with modified bicycle shorts for suspension. Using this system he explored functional advantages in collaboration with the outpatient interdisciplinary team. With the help of an innovative prosthetist, a custom-molded neoprene sleeve with a terminal threaded stud was eventually used for suspension (Figure 1).

The prosthetic limb improved cosmoses as well as the patient's self-perceived body-image. It also allowed him to wear standard socks, pants, and shoes. The prosthesis has an additional attachment site for his urine collection system. He experienced greater self-confidence when out in the community.

Discussion

Persons with SCI have compounding risk factors that can lead to limb amputation. The integrity of the lower limbs is threatened due to accelerated peripheral vascular disease progression, sensory deficit, risk for pressure ulcers, and infection of open wounds. In addition, wheelchair seating produces chronically flexed lower limbs making arterial circulation tortuous with shear at branch points. The venous circulation can develop deep vein thrombosis which produces valve damage and thus deficits in venous return. Furthermore, lack of voluntary muscle pumping and reduced sympathetic tone both compromise venous and lymphatic return. Ischemia can go undetected due to lack of volitional use to produce claudication and sensory deficits [4]. Osteoporosis, risk for falls and fractures further complicate patients' risk of amputation. These risks intersect in scenarios that produce clinical situations that make amputation imperative.

Historically, paralyzed limbs have been regarded as useless [6]. As recently as the 1950s, some physicians advocated for lower limb amputation for certain persons with paraplegia asserting that without limbs, they would be more mobile, more independent, and less susceptible to pressure sores. In the 1960s, this practice was more carefully scrutinized as physicians argued that amputation in patients with SCI should be subject to the same stringent indications as those applied in able-bodied populations [4].

The amputation of a paralyzed limb carries the possibility of several negative outcomes. In some cases, amputation converts a previously anesthetic limb into a painful residual limb that can transmit phantom pains. Even if these signals are not perceived, they could contribute as triggers for autonomic dysreflexia. Lower limb amputation in SCI patients leads to static instability and unequal pressure distribution. Unilateral amputees are more likely to lean towards their intact side; this increases the risk for scoliosis, biomechanical back pain, and pressure ulcer formation [6]. In high unilateral amputations, there is a substantial alteration in body symmetry and center of gravity; this predisposes to the development of hip abduction and flexion contractures [7]. Following unilateral hip disarticulations or bilateral transfemoral amputations, the perineum becomes a weight-bearing surface, which can lead to perineal pressure sores with urethral fistula formation. Thus, to optimize static balance and to reduce perineal pressure sore formation, it is prudent to maximize residual limb length [4].

The impact of amputation of a paralyzed limb on individuals' self-concept does not seem to be uniform. Unfortunately, an uncomplicated adjustment to amputation does not appear to be a consistent finding across all people with SCI. In a case review of 54 patients with paraplegia or tetraplegia undergoing major amputation, Grundy and Silver found that at least four patients in the series actually became severely depressed after amputation. This is a significant compounding risk that requires attention. In the general SCI population, 20 to 45 % of persons with SCI struggle with active clinical depression, and suicide is a leading cause of death in traumatic SCI patients less than 55 years of age [8].

Intuitively, amputation may worsen an already fragile body image, forcing the patient to deal with a new identity and way of life. Data, although sparse, suggests that this may not always be the case. Yetzer et al. found that people with SCI who underwent lower limb amputations actually had slightly more positive self-concepts, as measured by the Tennessee Self-Concept Scale, than those who had not undergone amputation. Grundy and Silver have suggested that because paralyzed patients are already disabled, they are able to adjust to the loss of a limb easier than able-bodied people.

The influence of lower extremity amputation on body mechanics and body image leads one to ask what role prostheses may play for people with SCI. Lack of sensation in a limb usually is a contraindication for prostheses because of the increased risk for pressure ulcer formation at the socket interface [7]. In their case review of people with SCI undergoing major amputation, Grundy and Silver found that prostheses can be successfully fit on insensate residual limbs without skin breakdown in daily use. Data was available for 23 persons; prostheses had been fitted for 11 and were acceptable in nine.

From a physiatric perspective of the interface of the patient to the environment the addition of prosthesis adapts the immediate environment [5]. This sector includes the skin and clothing and any adaptive devices (such as a wheelchair) that moves with the patient. The prosthesis can be viewed as a catalyst for preservation of skin and adaptive enhancement of function in this case. When considering any prosthetic, the patients success in interacting with all aspects of the environment must be considered [5], Figures 2-5.

A typical prosthesis for an individual with transfemoral amputation is comprised of a socket, a knee component, a shank and a foot/ankle.

Figure 1: The finished limb is pictured from a posterior perspective showing a custom neoprene suspension with attached pin lock mechanism and exoskeletal knee flexed prosthesis with attached urine collection system.

Figure 2: The patient is unloading and assembling his wheelchair upon arrival at the hospital. He is leaning forward over his left prosthetic limb utilizing it as a base of resting support and as a pillar of stability for hand contact. The right wheel has rolled away during assembly and he is retrieving it with a TeleHook system that he has designed himself.

Figure 3: Stable balanced upright seating enables many tasks to be carried that require trunk stability and use of both upper extremities.

Depending on user needs, each component may have a variety of styles or options. The socket is typically a custom fitted component that at least partially encompasses the residual limb. Fit is dependent in part on circulation, sensation and other considerations. Suction is one method of attachment, while some individuals may also need a femoral or pelvic belt to hold the prosthesis in place. The knee can vary greatly in complexity based on the user. Recent advances have allowed the computerization of the knee joint to enhance gait and conserve energy for prosthetic users. The shank is the area replacing the tibia. Options include exoskeleton style fabrication or endoskeletal pylon style. Finally, the foot-ankle component may offer fairly rigid control, single axis movement, or even multi axis movement as needed by the wearer.

A complete understanding of the daily routines and activities of the individual is imperative in prosthetic prescription to determine the correct components for a successful transition to regular prosthetic use. Financial restrictions from third party payors and other funding sources may influence patients' decisions regarding some of the high end components now available on the market. In our case, a simple prosthesis was utilized to offer symmetry and ultimately balance for the subject as he attempted to increase his participation at the community level and enhance his independence with activities of daily living.

The overall purpose of prosthesis is to give back to the patient some of the autonomy and freedom he or she lost subsequent to the spinal cord injury and resulting amputation. The new self-perception to which the patient is adjusting includes the reconciliation of taking his or her old, complete body for granted. Certain tasks that came naturally before the SCI are now ones that must be strategized and executed with awareness.

Traditionally, lower extremity prostheses for individuals with SCI have been considered cosmetic. Grundy and Silver found that the uses of prostheses for four high unilateral amputees helped restore the body weight lost by amputation and improve balance. By allowing a more balanced weight distribution, correcting wheelchair positioning, and decreasing chances for complications like scoliosis, back pain, and ulcer formation, lower extremity prostheses for those with SCI become functional and therapeutic. They are able to relieve the patient of these constant reminders as well as return some dignity and positive body image [9].

Figure 4: The photograph demonstrates the trunk balance afforded from seamless vacuum attachment of his right stump in the neoprene suspension attached to the LLE prosthesis.

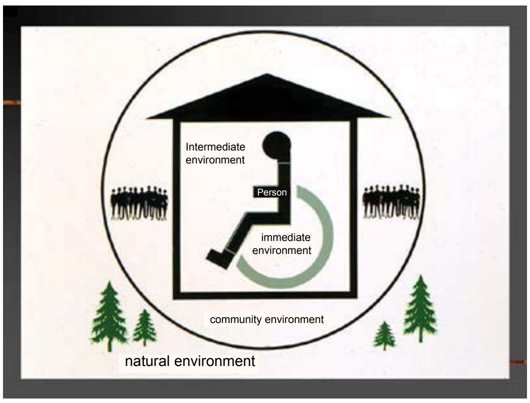

Figure 5: Sectors of the rehabilitation environment. Adapted from Physical Medicine and Rehabilitation Secrets 3rd Edition (p.78), by B.J. O'Young, M.A. Young and S.A. Stiens (Eds.), 2008, Philadelphia, PA: Mosby Elsevier. Copyright 2008 by Mosby, Inc. Adapted with permission.

Conclusion

This case highlights the potential benefits of prosthesis after amputation for a man living with thoracic paraplegia SCI. For person living with SCI prosthesis may be helpful with maintaining body image after amputation, but also offer functional benefits with regards to wheelchair mobility, transfer biomechanics, and pressure distribution. Despite the increasing risk for amputation and traditional standards for prosthetic solutions in people with SCI, access to these devices should be less restricted.

For ADLs the prosthetic is a scaffold for clothing and support to the wheelchair footrest. Prosthetic limbs provide the SCI patient a mechanism for relieving them of weight imbalances, back pain, and ulcer formation.

References

1. Yetzer EA, Schandler S, Root TL, Turnbaugh K (2003) Self-concept and body image in persons who are spinal cord injured with and without lower limb amputation. SCI Nurs 20: 18-23.
2. Chen Y, Devivo MJ, Jackson AB (2005) Pressure ulcer prevalence in people with spinal cord injury: age-period-duration effects. Arch Phys Med Rehabil 86: 1208-1213.
3. Fuhrer MJ, Garber SL, Rintala DH, Clearman R, Hart KA (1993) Pressure ulcers in community-resident persons with spinal cord injury: prevalence and risk factors. Arch Phys Med Rehabil 74: 1172-1177.
4. Grundy DJ, Silver JR (1984) Major amputation in paraplegic and tetraplegic patients. Int Rehabil Med 6: 162-165.
5. O'Young BJ, Young MA, Stiens SA (2008) "Environmental Barriers: Solutions For Participation, Collaboration, and Togetherness." Physical Medicine and Rehabilitation Secrets 3rd Edition, p. 76-86.
6. Ohry A, Heim M, Steinbach TV, Rozin R (1983) The needs and unique problems facing spinal cord injured persons after limb amputation. Paraplegia 21: 260-263.
7. Herman T, David Y, Ohry A (1995) Prosthetic fitting and ambulation in a paraplegic patient with an above-knee amputation. Arch Phys Med Rehabil 76: 290-293.
8. Hagen EM, Lie SA, Rekand T, Gilhus NE, Gronning M (2010) Mortality after traumatic spinal cord injury: 50 years of follow-up. J Neurol Neurosurg Psychiatry 81: 368-373.
9. Sousa AI, Corredeira R, Pereira AL (2009) The body in persons with an amputation. Adapt Phys Activ Q 26: 236-258.