CLINICAL REVIEW

Care of the Elderly Patient with Lower Extremity Amputation

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Background: **The elderly patient with a lower extremity amputation (LEA) remains relatively common in most family medicine practices. LEA can be categorized into three major types: partial foot, transtibial amputation, and transfemoral amputation. Family physicians have not been well trained to provide care to these patients.**

Methods: **A literature review was performed using the key words "lower extremity amputation," "aged" and "rehabilitation."**

Results and Conclusions: **Appropriate medical, surgical, and rehabilitative care can have a positive effect on the functional outcome for an elderly patient with a lower extremity amputation. The family physician can be instrumental in preparing the patient and family for surgery, providing psychological support, preventing and treating complications, managing comorbid illness, and assisting in rehabilitation. In addition, the family physician is primarily responsible for the daily care needs of these patients.**
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Despite improvements in medical and surgical limb salvage techniques, lower extremity amputation (LEA) remains a relatively common procedure. In 1993, 1,546,000 people in the United States were living with some form of major limb amputation.[1,2] Of the 127,000 limb amputation procedures done in acute-care, nonfederal hospitals that year, 98,000 involved the lower extremity.[1,2] The direct medical cost for a single LEA procedure is approximately $46,900.[3]

Methods

A literature review was performed using the key words "lower extremity amputation," "aged" and "rehabilitation." In addition, I drew upon personal experience and that of local experts.

Lower Extremity Amputation

LEA is disproportionately a problem of older men; 75% of patients who undergo LEA are male.[4,5] The incidence of LEA increases after age 55 years.[6] Although the average age of a lower extremity amputee patient is 51 to 69 years,[7] from 1910 to 1979, the age-related incidence of LEA increased fourfold for persons older than 80 years.[8,9] Despite medical and surgical advances in the treatment of the dysvascular limb, the overall incidence of LEA did not begin to decrease until the 1980s.[8,9] Still, the absolute number of older adults living with LEA has increased because of the aging of the US population and the increasing incidence of peripheral vascular disease with age.[6,8]

Diabetics have a 15-fold higher risk for LEA.[8,9] Risk factors for amputation among diabetic patients include older age, male sex, certain racial and ethnic groups, poor glycemic control, diabetes of longer duration, and poor preventive health care.[10] The risk for amputation in diabetics has declined in the last few years, probably as a result of improved diabetic control, changes in patient lifestyle, and the increased use of limb salvage vascular surgery.[9] Structured diabetes management programs have shown an overall reduction in subsequent LEA rate.[3,10] One program, implemented in a primary care setting, showed a 48% reduction in LEA during a 3-year period.[3] Structured diabetes management programs systematically implement comprehensive diabetes care according to practice guidelines.

The morbidity and mortality related to LEA remains considerable. Operative mortality rates

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Table 1. Lower Extremity Amputation (LEA) in the Elderly Patient.

Type of LEA	Percent of Total Number of LEA	Percent Recommended for Prosthetic Gait Training	Percent Using Prosthesis after Intensive Physical Therapy Program	Percent Additional Energy Required for Normal Bipedal Ambulation
Partial foot	50	Not applicable	Not applicable	0
Transtibial	25	60–80	60–90	Unilateral TTA: 40–60 Bilateral TTA: 60–100
Transfemoral or higher	25	20–30	0–40	90–120

TTA-transtibial amputation.
Adapted from Cutson and Bongiorni[6] and Andrews.[11]

range from 5% to 17% and postoperative (within 30 days) death rates vary from 2% to 23%.[6,9] Worsened mortality figures are associated with a higher amputation level and diabetes.[6,8,9] Age older than 80 years is also associated with decreased survival after amputation.[6] The mean survival for a LEA patient is 2 to 5 years.[9] The most frequent cause of death is cardiovascular disease. The incidence of ipsilateral reamputation ranges from 8% to 22%, but might be decreasing as a result of improved surgical techniques and more appropriate initial choice of amputation level.[6,8,9] The contralateral LEA rate within 4 years is 26% to 44%.[6,9] Most bilateral amputee patients have diabetes.[11]

Pathogenesis

Among older adults, vascular insufficiency, often with concomitant diabetes, accounts for approximately 75% of LEAs.[2,9,11] Twenty percent of LEAs are done as a result of traumatic limb damage.[2] Traumatic amputee patients tend to be younger and healthier than vascular amputee patients.[12] Benign or malignant tumors are responsible for the remaining 5% of amputations among older patients.[2]

Types of Amputation

LEA can be categorized into three major types, partial foot, transtibial amputation, and transfemoral amputation (Table 1).

Partial Foot Amputation

Transmetatarsel and more distal foot amputations usually cause minor functional problems.[13] Midfoot amputation procedures are not universally accepted because of the potential for equinus deformity, residual limb ulceration, and problems with prosthesis fitting.[13] There are functional benefits, however, gained from retaining the calcaneus and preserving ankle motion.[13] Ankle and hindfoot procedures are similarly controversial, except for a Syme amputation (disarticulation of the foot).[13]

Transtibial Amputation

Transtibial amputations are usually done at the junction of the upper and middle third of the tibia. For higher levels of transtibial amputation, it is usually better to preserve the knee joint, even if the remaining limb is short.[14] The knee joint is very important for functional gait and dramatically decreases the energy expenditure of ambulation.[6,7] As the level of LEA is higher, there is a progressive loss of proprioception and balance, leading to a less efficient and less functional gait.[6] Preserving the knee is especially important for elderly amputee patients, because they will more often have comorbid disease that might limit their exercise potential or adversely affect their baseline gait.[6]

Transfemoral Amputation

In general, transfemoral amputation with residual limb must be at least 4 to 6 inches in length from the groin to fit a prosthesis, but success is also dependent on adequate soft-tissue volume. The number of transfemoral amputations has declined since the 1980s.[9] This decline is probably due to improved surgical techniques, as well as better preoperative assessment of vascular status that more accurately determines the level of tissue viability.[6]

Table 1 contains a summary of the changes in the energy demands (kilocalorie per meter) of ambulation with various amputation levels. These increased energy demands can preclude ambulation for a small subpopulation of amputee patients or limit ambulation distance for a greater number of patients.[15] Most LEA patients compensate for the

higher energy demands of ambulation by walking more slowly, so that their energy expenditure is not increased. Because of the extreme energy demands (>200% more than normal bipedal ambulation), only young, healthy, motivated bilateral transfemoral amputation patients have a high success rate for independent ambulation.[6,9] For patients with concomitant comorbid disease, especially cardiac problems, the increased arm activity required for self-propelling a wheelchair can be stressful to the heart.[8]

Rehabilitation Potential

To estimate preoperative rehabilitation potential, it is important to establish the goals of the amputation procedure, estimate the functional prognosis, and select an appropriate site for rehabilitation. Depending on rehabilitation potential, the goal of LEA can vary from patient comfort only to restoration of an independent lifestyle.

To estimate rehabilitation potential, the family physician should assess the patient's overall medical condition, prognosis, cardiopulmonary reserve, cognitive and functional status, muscle strength, and the mobility of adjacent joints. Although being older than 80 years is associated with poorer rehabilitation outcomes, in general, comorbid illness, general health status, and level of amputation are more important than age in determining the outcome of rehabilitation.[6,16]

Barriers to successful rehabilitation include cognitive dysfunction that is severe enough to preclude training, severe neurologic impairment, irreducible knee or hip contracture, or comorbid disease (eg, congestive heart failure, angina, or chronic lung disease) that greatly impairs exercise tolerance.[6] Patients with impaired cognition have lower levels of functional improvement after rehabilitation, but might still be able to achieve major functional improvements that are maintained with time and that increase the chance for a home discharge.[17] A relative contraindication to gait training is vascular compromise of the contralateral extremity, which might worsen secondary to its increased weight-bearing load postoperatively.[6] Some experts, however, consider threatened gangrene of the contralateral limb an urgent indication for prosthetic training because of the increased risk of contralateral limb loss.[11,14] No single comorbid illness will universally contraindicate a trial of rehabilitation. Any amputee patient who has recently walked or has the potential to walk should be given an opportunity for rehabilitation in some setting.[14]

The medical, surgical, and rehabilitation care of the elderly amputee patient is complex because of the normal physiologic changes of aging, the common occurrence of comorbid disease, and the likelihood that the contralateral extremity is vascularly compromised.[9] Decreases in muscle strength, bone density, and maximum oxygen consumption with aging, as well as the increased susceptibility of elderly patients to deconditioning and other medical problems with even short periods of immobility, can lead to a more complicated postoperative and rehabilitative course.[6,18] Four percent to 29% of elderly amputee patients have had a stroke either before or subsequent to their amputation.[19] In addition, approximately 40% of elderly amputee patients have arthritis, and 20% to 30% have some impairment in hearing or vision.[11] Fifteen percent to 20% have overt heart disease, but many more have underlying asymptomatic coronary disease that might first come to medical attention during the rehabilitation phase of recovery when the elderly patient has progressed to a more physically taxing level of exercise.[11,20] More than 5% of elderly amputee patients also have cognitive dysfunction that could increase the chance of postoperative delirium.[11] Overall, elderly patients are more likely to develop postoperative medical problems (eg, congestive heart failure, stroke) that affect ultimate recovery.[6]

Stages of Care

The stages of care for an LEA patient are outlined in Tables 2 and 3. The family physician should be involved in almost all these stages of care and will have the primary role providing ongoing care to these patients.

Preoperative

An elderly patient with an imperiled limb often has other chronic medical problems that make the risk of surgical complications relatively high. As a result, the decision to first offer time-consuming, possibly unsuccessful, limb salvage surgery becomes very complex. Overall, vascular bypass surgery seems to reduce the incidence of subsequent lower extremity amputation, but a failed vascular procedure does predict a need for a higher level of

Table 2. Stages of Care for the Lower Extremity Amputee Patient

Stages	General Aspects of Care	Residual Limb Care	Patient Positioning	Physical Therapy/ Occupational Therapy	Psychological Issues	Patient Education
Preoperative	Determine level of amputation Control comorbid medical illnesses Assess preoperative and baseline functional status and mobility Control limb pain Provide preventive care of contralateral extremity (Table 3)			Range of motion and strengthening exercises Conditioning exercises	Provide information about the anticipated procedure Anticipate concerns regarding future vocational and lifestyle changes Establish support mechanisms for the patient and family	Educate regarding the anticipated rehabilitation process, expected functional changes and the possibility of phantom limb sensations Educate regarding preventive care of contralateral extremity (Table 3)
Operative	Appropriate surgical technique to form a residual limb that will better tolerate a prosthesis	Determine appropriate dressing for residual limb				
Acute postoperative	Pain control Wound healing Prevent immobility-related medical problems	Elevate residual limb for the first 24 to 48 h If no semirigid dressing, place gauze dressing covered by a noncompressive elastic wrap and knee immobilizer (to promote knee extension) Inspect wound daily	Avoid pillows between the patient's legs or under the back Have patient lie prone for 10 min, twice a day and gradually increase to 30 min, twice a day Leg dangle, or transfer to a chair, for at least 10 min, twice a day	Range of motion exercises for the residual limb Strengthening exercises for unaffected limbs Conditioning exercises	Supportive counseling for anticipated grief reaction	
Preprosthetic	Pain control Shaping and shrinking of residual limb Restore patient locus of control Maximize treatment of comorbid medical conditions and nutritional state Provide preventive care of contralateral extremity (Table 3)	Inspect wound Mobilize suture line through application of local pressure If no semirigid dressing, apply compressive elastic wrap	Continue prone lying Place leg board under the amputated limb when the patient is seated	Range of motion, strengthening and endurance exercises for all limbs Weight bearing at the parallel bars Train in bed mobility, transfers and wheelchair mobility Gait training with a temporary prosthesis	Supportive counseling for expected feelings of body image distortion, helplessness, dependency and depression along with fear of abandonment and need for contralateral amputation	Instruct in technique for mobilization of wound suture line and compressive ace wrapping Educate regarding preventive care of contralateral extremity and chronic care of residual limb (Table 3)
Prosthetic prescription	Selection of socket design and prosthesis suspension system	Change to elastic shrinker stocking once sutures are removed				Same as above
Prosthetic training	Increase wearing time of prosthesis Provide preventive care of contralateral extremity (Table 3)	Inspect residual limb for change or deterioration with regular prosthesis use	Continue prone lying	Gait training Training in activities of daily living (ADLs) and instrumental ADLs		Same as above
Community reintegration, vocational rehabilitation	Early discharge planning Determine patient's family, community, recreational and vocational needs and roles			Scrutinize home environment for needed patient access and maneuverability Assess for adaptive equipment (eg, toilet bars, tub bench) Assess need for continued therapy and vocational services	Maintain awareness of potential for social isolation and depression with new challenges of resuming family, community, and vocational roles Teach healthy coping strategies	Depending on vocational activities, might need further training or job modification

Adapted from Yetzer,[4] Butler et al,[5] Cutson and Bongiorni,[6] Esquenazi and Meier,[7] Andrews,[8] Andrews,[11] Penington et al,[14] Sarin et al,[20] Edelstein,[22] Mikulaninec,[23] and McAnelly and Faulkner.[24]

Table 3. Continuing Care of the Elderly Amputee Patient

General aspects	Regular assessment of patient's functional level and functioning of prosthesis
	Aggressive treatment of comorbid medical conditions
	Adequate nutrition and maintenance of consistent weight
Residual limb care	Inspect residual limb daily for abrasions, reddened areas
	Cleanse daily with gentle soap and tepid water and pat dry
	Massage scar
	Discourage shaving of leg
	Apply thin layer of bland emollient cream if skin is dry
Prosthesis care	Wash prosthetic socks or sheath daily with gentle detergent. Rinse and dry well
	Wipe socket daily with damp cloth
	Inspect socket and prosthesis daily for cracks or instability
Sexual function	Initiate discussion
	Determine the couple's attitudes and beliefs
	Educate regarding any expected changes in functioning
	Provide information to deal with balance or movement problems
Psychological issues	Lifelong emotional support
	Monitor for depression, social isolation
Preventive care of contralateral lower extremity	Daily skin inspection for abrasions, ulcers
	Professional nail and corn and callus care
	No chemical abrasives (eg, corn plasters)
	Treat fungal infections promptly
	Use only an electric razor to shave the leg
	Proper skin care (wash foot daily with gentle soap and tepid water. Apply thin layer of bland emollient for dry skin)
	Protect leg from excessive heat, cold, moisture, or trauma (eg, wear warm footwear in winter, no prolonged soaking of feet, avoid walking barefoot)
	Obtain appropriate footwear (well-fitting with extra depth and width of toe box)
	Inspect shoe before donning to remove retained debris. Do not wear shoe with torn or roughened areas
	Gradually and slowly increase wearing time for new shoes

Adapted from Leonard and Meier,[2] Esquenazi and Meier,[7] and McArelly and Faulkner.[24]

subsequent amputation.[9] After the decision for amputation is made, the surgeon must make an assessment of the appropriate surgical level that will insure tissue viability while addressing functional concerns. The challenge in initial choice of amputation level is to weigh the potential need for a surgical revision against the functional benefit of a lower amputation level that preserves the knee. Clinical limb assessment, noninvasive tests (eg, ankle-brachial Doppler index or segmental lower extremity pressures) and lower extremity arteriography can be informative.[21] An ankle-brachial Doppler index ratio of greater than 0.5 is associated with a greater than 90% success rate for healing a transtibial amputation.[21] A ratio of less than 0.35 is associated with a poor prognosis for healing a toe amputation.[21] Diabetic patients can have a spuriously high ankle-brachial pressure index despite considerable large- and small-vessel disease.[21] A popliteal artery segmental occlusion pressure of greater than 50 mm Hg is associated with successful healing of a transtibial amputation.[21] Despite the above tests, the final decision on amputation level can be made at surgery, where the amount of blood flow to tissues can be observed.

The family physician should play a major role in all other aspects of preoperative care. Control of comorbid medical illnesses preoperatively will decrease subsequent mortality figures.[21] Preoperative psychologic support is one of the most important roles for the family physician (Table 4). A patient's reaction to an anticipated limb amputation is related to age, sex, type of amputation planned, expectation of the success of rehabilitation, and the patient's perception of the functional value of the lost limb.[5] Body image concerns might be less important for elderly amputee patients.[5] In addition, the patient's premorbid personality and coping skills, previous losses, the amount and quality of social support, occupational and vocational de-

Table 4. Preoperative Psychological Support.

Discuss possible need for an amputation early in course of illness
Encourage family involvement
Clarify surgeon's information by providing data at an appropriate pace and educational level for the patient and family
Review treatment provided to try to preserve the limb
Reinforce potential for the operation to improve function and quality of life while avoiding false optimism
Help patient focus on the need for surgery
Encourage patient or caregiver to express fears and concerns
Discuss statements of self-blame
Identify anger, grief, and depression
Challenge heroic cheerfulness
Reinforce continuity of patient's personal characteristics
Elicit patient's coping reaction during past crises
Explore strategies to accommodate postamputation work, lifestyle, recreational needs

Adapted from Butler et al.[5]

mands, as well as the type and degree of comorbid illness, are important.[5] The supportive counseling initiated by the family physician in the preoperative period should be continued throughout the patient's operative, rehabilitative, and chronic care.

Preoperative physical therapy is helpful to prevent joint contracture and improve balance and muscle strength in the remaining limb.[7,8] Full range of motion of the more proximal joints of the affected limb is especially important to maximize postoperative mobility.[7] A preventive care plan for the remaining limb should be established because it will usually be at risk for ulceration and amputation also.

Operative

At surgery, attention is paid to appropriate soft-tissue coverage of the residual limb and placement of the suture line away from bony prominences so that the remaining limb will better tolerate a prosthesis.[7] A semirigid residual limb dressing (eg, Unna dressing) that is fabricated and applied at surgery or in the recovery room can decrease postoperative residual limb edema, healing time, and pain, and it can aid in shaping the residual limb and protect the new incision against traumatic damage.[2,9,22]

Acute Postoperative Care

Epidural medication for patient-controlled analgesia usually provides better postoperative pain control.[7] Phantom limb sensations are typical soon after surgery and do not necessarily require treatment.[7]

Initial elevation of the residual limb reduces the development of edema that can cause pain and delay healing.[7,23] Beyond the first 2 days, however, continued limb elevation can lead to a hip flexion contracture that could affect future mobility. Similarly, placing a pillow under the patient's back or thigh can lead to a hip flexion contracture.[24] A pillow placed between the patient's legs can lead to a hip abduction contracture.[24] Beginning on postoperative day 1, the patient should be asked to lie prone to prevent a hip flexion contracture. Early mobilization will reduce the development of orthostatic hypotension.[7,18]

Rehabilitation efforts must be continued immediately after surgery to prevent muscle weakness, orthostasis, contracture, and other immobility-related medical problems.[8,18] An overall medical plan to guard against immobility-related problems (ie, deep venous thrombosis, deconditioning) should be implemented.[18]

Preprosthetic Phase

The preprosthetic phase of rehabilitation includes continued attention to wound healing and appropriate control of residual limb pain. Enhancing the patient's nutritional status and treating comorbid medical conditions will improve wound healing. In addition to the aforementioned aspects of residual limb care, the patient should be taught mobilization of the suture line, which will decrease adhesions and desensitize the residual limb.[6,14] Continued use of a semirigid residual limb dressing or a compressive elasticized cloth wrap dressing will reduce edema and begin to shape the residual limb in anticipation of fitting a prosthesis.[22] Many references contain specific instructions for wrapping the residual limb.[4] These dressings can slip when the patient moves and require reapplication several times a day to maintain appropriate positioning and compression.[22] An elastic shrinker stocking can be used after the sutures are removed.[14,25] Typically, sutures are removed 3 to 4 weeks after surgery.

Positioning the patient is important in the preprosthetic phase. A leg board placed under the amputated limb will prevent a knee flexion contracture and reduce dependent edema.[4] Patients who are unable to lie in a prone position should lie supine and actively extend their amputated limb

while flexing the other leg.[24] Physical therapy at this stage is progressive. Early training in safe and independent wheelchair mobility will improve a patient's outlook and restore the locus of control.[11] Timely, appropriate rehabilitation is essential to enhance functional status within the remaining lifespan of the elderly amputee patient.[6] Coordinated or dedicated multidisciplinary teams can definitely improve rehabilitation outcomes.[6,8] The rehabilitation program for a geriatric amputee patient should be individualized according to the patient's health, physical status, functional status, motivation, and support systems.[11] For the patient whose amputation was the result of vascular compromise, the preprosthetic phase of recovery typically lasts 6 to 10 weeks.[2]

Prosthesis Prescription

Recent changes in prosthesis design and the use of ultralight materials have enhanced amputee function.[1,7,15] Factors relevant to the prosthesis prescription include the patient's general health, abilities, cognitive status, living arrangement, vocational and recreational needs, level of amputation, and the condition of the residual limb.[1,9] A great variety of prosthetic components, socket fabrication techniques, and prosthesis suspension systems are available.[7] A prosthesis is prescribed by a rehabilitation medicine physician.

A patient with a partial foot amputation requires a shoe filler (usually of sponge rubber or foam), shoe modification, or a slipper-type prosthesis according to the type or level of amputation performed.[2,24] Figure 1 displays the most common transtibial and transfemoral amputation prostheses. Because the prosthesis is adjusted to a particular heel height, the patient should be instructed always to wear shoes of similar heel height.[4]

Prosthetic Training

A permanent prosthesis is prescribed after a period of ambulation on a temporary device. The goal of prosthetic training is gradually to improve prosthesis wearing time and functional use. Initially the prosthesis should be worn for only 15 to 20 minutes a day. Full-time use will require a minimum of several weeks of training.[2] An elderly patient with an amputation will often require a gait aid for ambulation. If a cane is prescribed, it should be held in the hand contralateral to the prosthesis. It is important not to set lower goals for gait training because a patient is elderly.[7]

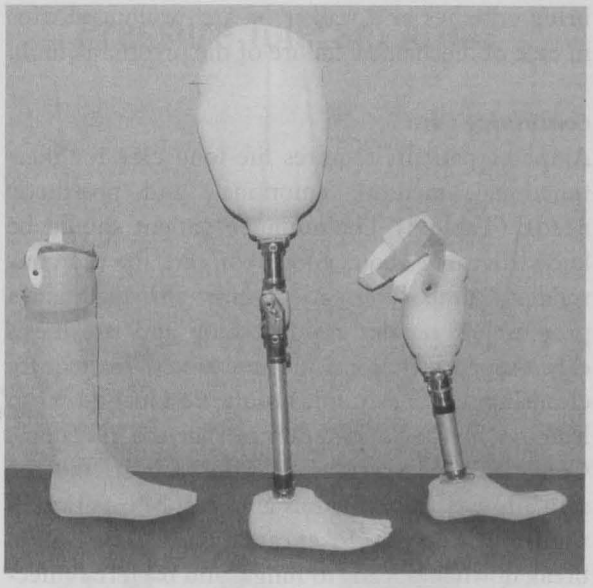

Figure 1. Right to left. Temporary transtibial amputation prosthesis: total contact patellar tendon-bearing (PTB) socket with supracondylar cuff attachment. Temporary transfemoral amputation prosthesis: quadrilateral socket with suction suspension system. Permanent transtibial amputation prosthesis: PTB socket with supracondylar strap attachment. (Courtesy of Carlow Orthopedic and Prosthetic, Warwick, Rhode Island).

Factors associated with successful prosthetic use include good general medical condition, a lower level of amputation, good muscle coverage of the residual limb, nontraumatic operative technique, and absence of residual limb pain.[9,11]

Community Integration and Vocational Rehabilitation

Depending on the study quoted and the level of LEA, from 20% to 80% of elderly patients return home after LEA rehabilitation.[6] Independence in activities of daily living is a key factor for a successful home discharge.[9] Although the amputee patient might return home, poor mobility in the community and difficulty reintegrating into work and recreational activities often occur.[26] Possible social isolation is a particular concern with elderly patients. Specialized instruction and automobile modifications are required for the patient to resume driving.[27] The patient should be instructed to

bring crutches or a walker on any prolonged trips in case of mechanical failure of the prosthetic limb.

Continuing Care

Amputee patients requires life-long care for their functional, medical, emotional, and prosthetic needs. (Table 3) The amputee patient should be knowledgeable about good foot care for the contralateral limb. The patient must also maintain a program of regular residual limb and prosthesis care. Appropriate local hygiene is key. Inadequate cleansing in the skin folds of the residual limb can lead to mechanical irritation and surface infections. Conversely, overzealous cleansing can dry out the skin and cause eczematous changes. Maceration of the skin within the socket can also cause the skin to break down and leads to fungal and bacterial infections. Cornstarch, unscented talc, or an antiperspirant can control excessive moisture.

Prosthetic socks are often used at the interface of the limb and the socket of the prosthesis to adjust for physiologic volume changes throughout the day.[7] Natural fiber materials will absorb local moisture. The sock must be pulled free of wrinkles and the seam positioned away from any bony prominence or scars before donning the prosthesis. Unless the patient wears the prosthesis consistently, an elastic shrinker stocking should be worn to maintain proper pressure and control local swelling.

An often unattended need of amputee patients is attention to sexual concerns. The LEA patient might interpret silence on this subject as a sign of prohibition. The patient's overall health and the couple's previous attitudes, beliefs, and experiences should be elicited. Amputee patients should be told that they might expend slightly more energy during intercourse, which could result in mild fatigue.[28] Phantom limb pain can also occur with orgasm.[24] The rehabilitation physician or the physical or occupational therapist can provide helpful information if the patient's balance or movement during sexual intercourse causes problems. Psychologic issues affecting sexual function include an altered body image, depression, and anxiety about disease progression.

Physician Follow-up

Because of frequent changes in the size and shape of the residual limb within the first 6 to 18 postoperative months, the patient should return to the rehabilitation physician during this time for any socket adjustment needed. Otherwise, yearly follow-up visits are recommended.

The family physician should also attend to issues relating to the LEA during continuity care visits. The frequency of visits to the family physician is often dictated by the care needs of any comorbid medical disease, but they should usually be no less often than every 6 months. Aggressive treatment of comorbid medical conditions, such as diabetes and arthritis, is important to prevent deterioration of the residual limb.[27] It is important that the patient maintain a consistent body weight, because a change of as little as 5 pounds can lead to poor socket fit.[4,11] A poorly fitting socket can lead to skin irritation and breakdown and cause local pain.[12] The family physician should inquire about residual limb or phantom limb pain, especially if the former occurs with ambulation. Precise localization of the pain can help to focus subsequent physical examination. The family physician should also inquire about any problems with prosthesis fit or function. The occurrence of any falls, along with the circumstances, might highlight prosthesis problems. At each visit, the patient's functional status and mobility should be documented, and potential reasons for any deterioration explored.

Both of the patient's lower limbs should be inspected for skin abnormalities, especially areas of redness or ulceration. The scar on the residual limb should be mobilized to ensure movement in all directions. Adherent scars can become a source of pain. Any erythematous or painful areas should be palpated. For the transtibial residual limb, there are pressure-tolerant and pressure-sensitive areas (Figure 2). Localized pain, tenderness, or erythema over a pressure-sensitive area requires a visit to the rehabilitation physician, because there could be a problem with prosthesis fit. Because of the differing anatomy, there are no similar high-risk pressure areas on the transfemoral residual limb. Next, the prosthesis should be examined for cracks or instability. The average life expectancy of a prosthesis is 3 to 5 years.[2] Finally, the physician should watch the patient ambulate. Malalignment or other prosthesis problems can cause limb pain and recurrent skin breakdown and affect the balance, stability, and efficiency of gait.[15]

Problems with the Residual Limb

Changes in the residual limb or prosthesis can cause or contribute to multiple long-term patient

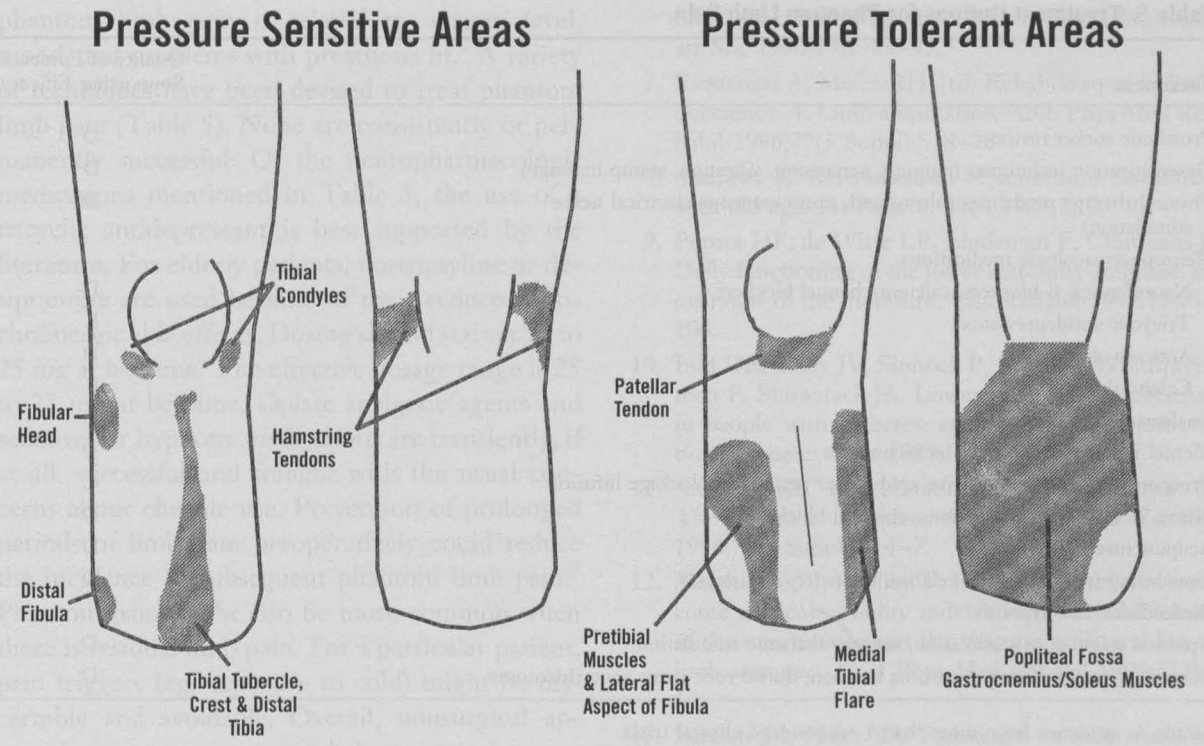

Figure 2. Pressure-sensitive and pressure-tolerant areas of the transtibial residual limb.

problems, including residual limb pain, phantom limb pain, neuroma formation, choke syndromes, skin irritation or breakdown, skin lesions, and gait abnormalities.[1]

Residual Limb Pain

Causes of residual limb pain include skin irritation, infection or ulcer, underlying osteomyelitis or osteophyte, limb ischemia, neuroma, epidermoid cyst, a poorly fitting prosthesis, sensitive scar, and reflex sympathetic dystrophy.[7,27,29] Persistent or late-onset residual limb pain can be secondary to all the causes of pain mentioned above. Palpation over a neuroma, a common cause of late-onset residual limb pain, will characteristically elicit lancinating discomfort. Neuromas can be treated surgically or with a local injection of an anesthetic-steroid mixture.[7] Socket adjustment might be necessary.

Skin Irritation or Breakdown

A contact or allergic dermatitis can develop from the materials used in the socket liner or soap residue left on the liner. Chronic ulcers of the residual limb can be the consequence of persistent edema, bacterial infection, vascular disease, or localized pressure from an ill-fitting prosthesis.[25] Malignant change can occur in these chronic ulcerations, and recurrent ulcers could lead to scarring that affects socket fit.[25] The patient should contact their physician and not wear their prosthesis if irritation or ulceration develops.

Skin Infection

The skin of the residual limb contains many more bacteria than normal, and resistance to infection is lowered by local skin irritation. In addition, the skin within the prosthesis is always somewhat moist, which can lead to increased bacterial and fungal growth. Excessive heat and humidity, poor hygiene, uncontrolled diabetes, and poor prosthesis fit are all associated with an increased likelihood of local infection.[25] Infection can occur as an area of cellulitis, superficial crusting pyoderma, folliculitis, or furuncle. Skin infection in the residual limb can require oral or parenteral antibiotics depending on severity and response to therapy. Bacterial infection is usually caused by coagulase-positive staphylococci or β-hemolytic streptococci; therefore, an antistaphylococcal penicillin or first-generation cephalosporin is an appropriate antibiotic choice. A furuncle requires warm compresses and incision and drainage. Fungal infections require extended

Table 5. Treatment Options for Phantom Limb Pain.

Treatment	Quality of Evidence Supporting Efficacy
Prosthetic socket revision	D
Desensitization techniques (tapping, percussion, vibration, stump massage)	D
Physical therapy modalities (ultrasound, transcutaneous electrical nerve stimulation)	D
Neuropharmacologic medications	
Neuroleptics, β-blockers, calcium-channel blockers	D
Tricyclic antidepressants	B
Anticonvulsants	D
Calcitonin	B
Analgesic medications	D
Mental imaging and relaxation techniques	D
Preoperative and postoperative epidural or perineural blockage infusion	C
Nerve blocks, steroid injections, epidural blocks	D
Acupuncture	D
Counseling (recognition of relation to anxiety and stress)	D
Biofeedback and hypnosis	
Epidural spinal cord stimulation, sensory thalamic stimulation	D
Surgery: sympathectomy, neuroma excision, dorsal root entry zone rhizotomy	D

Grade A: evidence from more than 1 randomized clinical trials
B: evidence from clinical trial and/or more than 1 nonrandomized studies
C: evidence from 1 nonrandomized study and/or conflicting evidence with the majority of evidence supporting efficacy
D: common practice with no well-conducted studies supporting efficacy
Adapted from Esquenazi and Meier,[7] Panerai et al,[30] Jaeger and Maier,[31] Patterson,[32] Bach et al,[33] Nikolajsen et al,[34] and Horn[35]

periods of treatment with fungicidal creams or powders or, in severe or recurrent cases, with oral antifungal agents.

Skin Lesions

Epidermoid cysts develop from persistent frictional damage and are usually found at the margin of the prosthesis. Treatment is incision and drainage and avoidance of prosthesis use until the lesion is healed. The prosthesis will likely need to be refit. The patient should be referred promptly to the rehabilitation physician for any recurrent or chronic skin problems as seemingly minor abnormalities can, with inattention or mistreatment, develop into problems that could imperil future ambulation.

Choke Syndrome

A choke syndrome is a potentially serious cause of residual limb pain that should be detected. If the prosthetic socket fits tightly around the proximal residual limb, but the distal residual limb is not in good socket contact, there will be obstruction of venous outflow, and distal limb edema will develop. If unchecked, erythema, induration, and eventual skin breakdown ensues.[2] Treatment is a socket revision.

Phantom Pain

Phantom limb discomfort should be differentiated from residual limb pain. Phantom limb pain is often described as knifelike, burning, aching, squeezing, or similar to the pain felt in the ischemic limb preoperatively.[4] Phantom limb pain should be differentiated from phantom limb sensation, which is the feeling that all or part of the missing limb is still present. This later sensation is felt by most amputee patients and is usually mild and transient. A patient with phantom limb sensation should invest in a night-light to decrease the chance of injury secondary to an attempt to ambulate on a nonexistent extremity.

Far fewer patients have phantom limb pain that becomes physically, functionally, and emotionally debilitating. Phantom limb pain persisting for more than 6 months will likely be chronic and difficult to treat.[7] The cause of phantom limb pain is not precisely known.[24] The perceived intensity of

phantom limb pain is related to anxiety level, mood, and problems with prosthesis fit.[7] A variety of techniques have been devised to treat phantom limb pain (Table 5). None are consistently or permanently successful. Of the neuropharmacologic medications mentioned in Table 5, the use of a tricyclic antidepressant is best supported by the literature. For elderly patients, nortriptyline or desipramine are used because of their reduced anticholinergic side effects. Dosing should start at 10 to 25 mg at bedtime. The effective dosage range is 25 to 75 mg at bedtime. Opiate analgesic agents and sedatives or hypnotic medications are transiently, if at all, successful and fraught with the usual concerns about chronic use. Prevention of prolonged periods of limb pain preoperatively could reduce the incidence of subsequent phantom limb pain.[7] Phantom pain might also be more common when there is residual limb pain. For a particular patient, pain triggers (eg, exposure to cold) might be discernible and avoidable. Overall, nonsurgical approaches are more successful than surgical procedures.[7]

In summary, the family physician can help prepare the LEA patient for surgery, provide psychological support, prevent and treat complications, manage comorbid illness, assist in rehabilitation, and attend to chronic care needs. The relatively short long-term survival of amputee patients heightens the need for aggressive medical and rehabilitative care to enhance the quality of the patient's remaining years.

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