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Managing the Upper Extremity Amputee: A Protocol for Success

CPT Lisa M. Smurr, OTR/L, CHT
United States Army Health Clinic — Schofield Barracks, Schofield Barracks, Hawaii

Kristin Gulick, OTR/L, BS, CHT
Advanced Arm Dynamics, Portland, Oregon

MAJ Kathleen Yancosek, MS, OTR/L, CHT
Walter Reed Army Medical Center, Washington, DC

Oren Ganz, MOT, OTR/L
Walter Reed Army Medical Center, Washington, DC

ABSTRACT: Since the beginning of Operation Enduring Freedom and Operation Iraqi Freedom, over 541 clients with major limb amputations have been seen in the Military Healthcare System. As a result of the nature and severity of injuries and the prevalence of concomitant injuries seen in this population, amputee care has become a specialized type of rehabilitative care at Walter Reed and Brooke Army Medical Centers. To streamline and accommodate the needs of clients with upper extremity limb loss, a five-phased upper extremity amputee protocol of care was developed. The five phases of the protocol include acute management; preprosthetic training; basic prosthetic training; advanced prosthetic training; and discharge planning. For the readers ease, these phases will be presented in the following categories: acute care, subacute care, and long-term rehabilitation needs. Furthermore, this article seeks to offer insight into the ideal treatment of an individual with upper extremity limb loss based on experience and collective expertise of the authoring therapists.

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As stated by Dillingham ''the care of amputees is a major problem facing any Army during wartime.''[2] The significant trauma experienced in battle results in substantial numbers of upper and lower extremity amputees. History demonstrates that these numbers far outweigh those seen in civilian medicine. For this reason, amputee care in the military must remain at the forefront of technology, maintaining its readiness to assume the full care of treating Service members with a limb loss.[1] The rehabilitation teams at Walter Reed Army Medical Center (WRAMC) in Washington, DC and Brooke Army Medical Center (BAMC) in San Antonio, TX have paved the way in development of a comprehensive upper extremity amputee protocol. As of January 2007, there have been a total of 541 major limb amputations seen and of this population there have been 111 unilateral upper limb amputees, 6 bilateral upper limb amputees, and 13 combined upper and lower extremity amputees.[1] Of the clients treated, 43 military personnel have returned to active duty, 10 of which have been individuals with upper extremity limb loss.[2]

In the civilian sector, trauma is the leading cause of upper extremity amputations (90%) and other causes include burns, peripheral vascular disease, neurological disorders, infections, malignancies, contractures, and congenital deformities.[3] The causes of military amputee injuries include mortars, gun munitions, improvised explosive devices (IEDs), and rocket propelled grenade launchers. As a result of such high forces, velocities, and temperatures at the time of injury, most combat injured personnel seen at military medical facilities have also sustained other concomitant injuries in addition to amputation(s). Concomitant injuries range from traumatic brain injury to visual loss, hearing loss, massive soft tissue loss, fractures, and nerve and vascular damage. Frequently, multiple extremities are involved and although injuries may be similar, no two clients are alike.

The environment for amputee rehabilitation at WRAMC and BAMC is ideal. Prosthetists specializing in upper extremity prosthetics are present on site working jointly with occupational therapists (OTs) and occupational therapy assistants in the care and management of upper extremity amputees. Additionally, clients stay on the campus of each

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Correspondence and reprint requests to Lisa M. Smurr, OTR/L, CHT, United States Army Health Clinic — Schofield Barracks, Schofield Barracks, 95-1007 Kuauli St. #144 Mililani, HI 96789; e-mail: <lisa.smurr@us.army.mil>.

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facility while they undergo comprehensive rehabilitation and reintegration into the community with their prosthesis.

A standardized, comprehensive, five-phased protocol of care was developed to address the unique rehabilitation needs of combat wounded individuals. Phase 1 addresses acute management and wound healing; phase 2 marks the introduction of preprosthetic training; phase 3 embarks on prosthetic training; phase 4 focuses on advanced functional training; and phase 5 involves discharge planning. Overlap occurs between each phase to allow flexibility of client progression based on severity of injuries, wound healing, and client tolerance. Throughout each phase care is individualized to meet the needs of each client. As the client becomes medically stable, occupation-based goals are established. A different aspect of therapy is introduced within each phase to help the client progress to full recovery. The goal for rehabilitation of the upper limb military amputee is provision of the necessary skills and tools required to achieve prosthetic acceptance and reintegrate psychologically, socially, and physically back to the military unit or to civilian life.

For the purposes of this article, we have introduced the management of the upper limb amputee from the acute treatment, subacute treatment, and long-term planning needs. The objective of this article is for hand therapists to gain a general understanding of how to manage an upper extremity amputee through a client-centered approach to rehabilitation.

ACUTE MANAGEMENT

When managing an amputee acutely, the rehabilitation goals are to promote healing of the residual limb wound; achieve independence in self-feeding, toileting, and oral hygiene; and provide the client and family education on the rehabilitation process. This phase begins at the time of injury and continues until all wounds have successfully closed and are free of infection. The length of time spent in this phase varies depending on the extent of the client's injury. Clients and family members are introduced to rehabilitative and prosthetic services in the early stage of this phase. It is imperative that these interventions begin early on to ease client and family member's fears, provide support throughout the grieving and recovery processes, and engage the client and family with the rehabilitative team. The components of this phase include comprehensive evaluation, wound healing, edema control, desensitization and scar management, pain control, gross motor activity, and psychological support.

Evaluation

An orthopedic OT evaluation is administered in a holistic approach to obtain baseline information of the client's physical and emotional status. The evaluation includes the client's current status, background, abilities, and future goals. Medical history is obtained with special attention to all injuries that impact inpatient care and injuries that impact the client's long-term goals. The evaluation includes an in-depth information gathering interview with the client and family members to identify premorbid lifestyle, hand dominance, educational level, vocation, and recreational interests. The client's current living situation is reviewed to determine the level of family support available and any physical/environmental limitations, which may now pose problematic. Current medications and the client responses to these medications are documented. It is critical to screen each client's psychosocial status to appropriately gauge treatment intervention.

The physical components of this evaluation include assessment of the upper quadrant range of motion on the affected and unaffected sides; bilateral manual muscle testing; limb volume measurement; wound description; scar evaluation; and sensitivity of the residual and intact limb. It is important to determine the residual limb sensation as hyposensitivity or hypersensitivity is the necessary consideration in fabrication and fitting the prosthetic socket. The evaluation includes a thorough determination of pain of the residual limb, phantom pain, and phantom pain as it differentiates from phantom sensation. Additionally, a functional evaluation similar to the Functional Independence Measure™ (Uniform Data System for Medical Rehabilitation, Amherst, NY) is completed.

Prehension evaluations are performed as appropriate for each client to determine baseline function of the remaining limb as a sound limb will be responsible for performing all fine motor and dexterity tasks for vocational and leisure purposes. Common evaluations include Jebson-Taylor hand function evaluation; Minnesota Rate of Manipulation Test, Boxes and Blocks, and Nine Hole Peg tests.

Basic Self-care Activities of Daily Living

Training in self-feeding, toileting, and oral hygiene are introduced as soon as possible. Various commercial and custom adaptive equipment aids are presented to facilitate independence in these areas, as necessary. Regaining a sense of independence with basic self-care tasks can assist the patient immensely in their recovery both physically and psychologically.

Wound Healing

Due to the nature of explosive and thermal injuries, the wounds that remain are heavily contaminated and are left open to allow for multiple washouts in the operating room. This reduces the risk of infection

and further tissue damage. Depending on the type and size of the wound, various procedures to promote healing are used to include the use of drains, intraoperative antibiotic bead placement, or negative pressure wound therapy through the vacuum-assisted closure systems. A figure of eight wrap is used for distal-to-proximal compression and shaping over the healing distal aspect of the residual limb. Once the wound stops seeping, the client progresses to a sewn Compressogrip™ sleeve (Alimed, Dedham, MA), which is tapered at the distal end of the residual limb. As the wound closes and the mature scar tissue forms, the client is instructed in the wear of a silicone liner that provides continuous force compression with the added benefit of minimizing scar.

One of the goals for the client, or their family member as appropriate, is to be able to independently don and doff compression garments. The compression garments are changed frequently throughout the day to maintain consistent concentric pressure distally to proximally on the residual limb. Edema control measures are implemented to assist in decreasing limb volume to prepare for fitting of a preparatory prosthesis.

Desensitization

Desensitization begins with the use of the aforementioned compression techniques, massage, tapping, and the use of texture bins for immersion of the hypersensitive limb. Desensitization is performed 20–30 minutes three times per day as the client's skin and scar tolerates. It is imperative that the client's residual limb not be hypersensitive as this will decrease their tolerance to wear of the prosthetic socket. Clients and family members are also instructed in self limb massage and desensitization outside of the clinic as this is such a critical part for success.

Pain Control

The pain experienced after an amputation can be broken into two distinct categories: phantom limb pain and residual limb pain. Phantom limb pain is described as pain in an absent limb or portion of a limb.[4] Residual limb pain is described as pain in the part of the limb left after the amputation.[5] Although these types of pain are distinct, there are common and unique treatment approaches for management.

Regardless of the type of pain, management begins in the immediate postoperative status with a patient-controlled analgesia (PCA) pump and is continued using long-acting opioids after discharge of the PCA. Short-acting opioids can be used for breakthrough pain. Anticonvulsants, tricyclic antidepressants, and nonsteroidal anti-inflammatories are frequently also used. Appropriate therapeutic interventions and modalities for managing both types of pain include the use of transcutaneous electrical nerve stimulation, ice, heat, massage, functional tasks to encourage normal motor pattern of the painful extremity, desensitization, and continuous psychological support through the therapeutic use of self. The use of a mirror box in which the uninvolved side is visually reflected as the missing side, has been shown to decrease phantom limb pain in some cases by Dr. Ramachandran and colleagues.[6,7] Interventions for pain control are continuous through the multiple phases of rehab.

Phantom sensation is frequently experienced in amputee recovery. Phantom sensation is defined as any sensory phenomenon except pain, referred to an absent limb or portion of a limb.[5] The occurrence of this type of sensation can be very concerning to clients; however, it is important to reassure them that this is a normal experience and it may change over time.

Gross Motor

Gross motor refers to range of motion and body symmetry. After limb loss, the client frequently compensates with shoulder elevation on the affected side. To prevent additional postural compensations, visual feedback is provided using a mirror during the performance of basic range of motion exercises to proximal joints on bilateral sides.

Psychological Support

Psychological support is integral for successful rehabilitation and it begins during the first interaction with the client. From the therapeutic standpoint, psychological support encompasses client and family education throughout the recovery process, life skills management, and the therapeutic use of self.

Psychological issues frequently seen in an amputee population include fear of the unknown; loss of self-esteem; loss of self-confidence; fear of rejection; and loss of occupational roles. Providing therapeutic intervention is not solely provided by the therapist but by the team as a whole. Methods of psychological support include education on the rehabilitative process to allay fears of the unknown; reinforcement of the client's personal style; reassurance of normalcy of the client's response to amputation; engagement in empathetic interaction with both the client and family; provision of an amputee peer visitor trained through the Amputee Coalition of America® (Amputee Coalition of America®, Knoxville, TN); involvement in preventative medical psychiatry; engagement in weekly therapeutic outings; and helping the client ascertain life skills to successfully transition to "real life" after hospitalization.

In the acute stage, the client is supported appropriately as their needs change. Therapists provide introductory education on the rehabilitation process,

reassurance that the client can return to a successful and productive life that he or she may choose, encouragement to engage in meaningful occupations, reassurance of normalcy of feelings throughout the initial and subsequent stages of emotional and physical recovery, and therapeutic use of self to engage the client in their recovery process.

SUBACUTE MANAGEMENT

Approximately, two to three weeks after injury depending on medical circumstances, concomitant injuries, and the ability to perform self-care in a controlled living environment, Service members may be discharged from inpatient status. Management of the amputee during the subacute phase encompasses preprosthetic, prosthetic, and advanced prosthetic training.

Preprothetic Training

The rehabilitation goal of preprosthetic training is to prepare the client and their limb to receive a correct fitting and functional prosthesis. This begins upon wound closure and ends with acquisition of a preparatory prosthesis. Time spent in this phase varies depending on changes in limb volume, sensitivity, ROM, physical condition of the residual limb, and the client's psychological status; therefore, portions of acute management continue as necessary to address these deficits.

The client requires additional psychological support from therapy as they progress emotionally from ''combat'' survival mode, through the awareness that they have survived a combat-related injury, to the realization that they will have to live with an altered body throughout the rest of their life. It is imperative that psychological support is continued and modified to appropriately respond to the rapidly changing needs of the client as they advance through the grieving process. Education is provided regarding the extensive possibilities of function with a prosthesis. Part of this education may include providing a realistic picture of prosthetic function as clients have varying perceptions of a prosthesis from that of a picture of Captain Hook to the opposite extreme of an unrealistic superhuman bionic arm. Psychological support is further enhanced by the addition of a peer support or peer visitor, which provides a significant aid in coping for the client.

It has been the experience of this rehabilitation team that the client rapidly progresses through the grieving process once preprosthetic training is initiated. The supportive psychological services available, the therapeutic milieu, participation with other clients or peers with limb loss, and the performance of occupation-based activities in an environment promoting recovery provide the basis to achieve psychological healing. Clients who overcome the grieving process frequently begin to verbalize or display their injury in a humorous light. Clients purchase and wear various clothing paraphernalia with sayings such as ''dude where's my leg,'' or ''IEDs suck.'' Although many of the statements are a crude representation of humor, it is a valuable clinical sign that the client has ''broken through'' the grieving process, entered the acceptance phase of recovery, and is able to project humor in regard to amputation.

Postural Exercises and Strengthening

In addition to maintaining upper quadrant range of motion, it is necessary to introduce postural exercises for body symmetry and upper quadrant strengthening. Clients participate in physical therapy to achieve improved trunk and lower body flexibility and strength as well as aerobic condition. Emphasis is placed on educational awareness of altered body patterns with use so as not to develop incorrect postures that may lead to cumulative trauma or overuse injuries of the upper extremities, neck, or back. The client is educated on the signs and symptoms of various cumulative trauma disorders and is encouraged to seek initial medical attention early on if theses signs or symptoms develop. Little information has been published on the prevalence of overuse injuries in the upper limb amputee population; however, a small study published by Jones and Davidson[8] found overuse injuries were much more common in the unilateral amputee population than the nonamputee population.

Body symmetry awareness training often begins with observation of static postures in front of a mirror and is rapidly progressed to dynamic postural awareness by incorporating the use of a mirror during therapeutic dynamic activities. For example, the client performs exercises and tasks in front of a mirror and the therapist provides additional verbal and tactile cues as necessary. The client is encouraged to use muscle memory to re-learn correct postural control during activity outside of the clinic.

Isometric and isotonic strengthening exercises are initiated with the use of a mirror to provide the client visual feedback on proper form. Strengthening equipment is modified as necessary to allow for the use of the residual limb. Scapular stabilization exercises and core strengthening are also introduced to support good posture. In addition to strengthening, the client participates in aerobic conditioning regime.

Activities of Daily Living, Adaptive Equipment, and Change of Dominance

As wounds heal, the client progresses to more complex activities of daily living (ADLs) such as showering, facial hygiene, dressing, simple meal

prep, and laundry activities. To aid in independence, the client is trained in compensatory techniques in addition to the introduction of a wide array of commercial and custom adaptive equipment. Ultimately, each client chooses the method(s), which work most effectively for him or her. Most clients prefer to minimize the number of adaptive aids that they use due to the constrictions equipment may pose for flexibility in task performance in different environments. Focus is specifically placed on the client mastering independence in one-handed ADLs as there will be times when the prosthesis is unavailable. The client must have mastery in performing one-handed ADLs independently, efficiently, and ergonomically correct to avoid the possibility of developing cumulative trauma disorders. As mastery in basic ADLs is found, the client begins to explore instrumental ADLs.

Change of hand dominance training is introduced as necessary. On the basis of the limitation of fine motor prehension capabilities of any available prosthesis, it is important to teach the client change of dominance in handwriting to ensure one-handed independence. Some clients perform this task with hesitation as they hope to use the prosthesis to perform writing tasks. Time will be spent for a bilateral upper extremity amputee to gain necessary skills for writing with a prosthesis using a hook terminal device (TD). Fine motor activities used include use of tweezers, spray bottles, twisting caps on and off, twisting nuts on and off of bolts, lacing activities on a vertical surface, and rolling putty balls. These types of activities encourage radial digit coordination, separation of radial and ulnar sides of the hand, and wrist extension. These are necessary motor components of handwriting. The client is instructed in rote penmanship exercises using progressive motor writing activities culminating in sentences with at least one character each from the alphabet: ''The quick brown fox jumped over the lazy dogs.'' Clients also spend time learning one-handed keyboarding to facilitate success in computer operations. All therapy tasks aim to improve overall fine motor control, hand coordination, and dexterity skills.

Myosite Testing and Training

Due to the rapid medical evacuation of a Service member from the battlefield to WRAMC or BAMC, early and aggressive prosthetic rehabilitation is possible. For this reason, Service members are fit with electric prosthetic systems that create less shear force and end bearing forces on the healing residual limb. In instances where early prosthetic fitting is not possible, the residual limb will require further preparation for either a body-powered or electric prosthesis. Many Service members are fit with an activity-specific prosthesis, which allows them to participate in meaningful leisure and recreational pursuits or interests.

Research has demonstrated that individuals fit with a prosthesis within 30 days of amputation exhibited a 93% rehabilitation success rate with a 100% return to work rate within four months of injury and those fit beyond 30 days exhibited a 42% rehab success rate with a 15% return to work rate within six to 24 months.[9] This 30-day period is termed the ''golden window.''[10] The extensive multiple injuries incurred during combat can challenge the rehabilitation teams at WRAMC and BAMC in achieving initial prosthetic fitting on combat injured clients within this golden window. The impact of this problem has been managed through the use of technology. Within two- to three-week postinjury, clients treated at these two facilities begin socket electrode site identification and training necessary for operation of a myoelectric prosthesis. The goals of this early intervention training are to identify, instruct, and train the client to independently, correctly, and efficiently use specific residual limb musculature to activate and perform basic myoelectric prosthesis functions, resulting in the ability to immediately operate the myoelectric prosthesis at first fitting.

Electrode site identification takes place in therapy with use of socket electrodes (see Figure 1) and either/or MyoBoy® software (Otto Bock©, Minneapolis, MN), the MyoLabII (Motion Control, Inc., Salt Lake City, UT), or therapeutic biofeedback units. The process of site selection involves multiple factors and requires specialized skill of trained therapists and prosthetists to identify the best possible electrode

FIGURE 1. *Socket electrode used for myoelectric training. This same type of electrode is placed within the myoelectric prosthetic socket. Courtesy of Otto Bock®, Minneapolis, MN.*

placement and the most effective control scheme for each client's particular abilities and needs.

For ease of learning, optimal muscle sites are selected based on what is most intuitive to the patient. Flexors are used to activate TD closing and pronation, and extensors are used to activate TD opening and supination. Electrodes pickup signals most effectively over superficial muscle bellies with healthy skin coverage. Selecting the placement of electrodes requires knowledge of socket design. This knowledge aids the therapist in locating a muscle site that is well contained within the limits of the socket. Furthermore, the sites located in training are used to identify the correct placement of the electrodes within the future prosthetic socket. Once ideal sites are identified, motor training begins.

Motor training takes place using computer-based MyoBoy® software (Otto Bock©, Minneapolis, MN) and the socket electrodes. On an EMG-like screen, the client can visualize color-coded signals, representative of each of the selected electrode site muscles, as they are activated for the corresponding TD operation (see Figure 2). Initially, the focus of training is on independent activation of each muscle. When the client is able to demonstrate separation of these muscle signals the concept of proportional control is introduced. Proportional control is a term used to describe the proportional relationship of the elicited strength of the selected muscle contraction to the speed and grip force of the TD. Many myoelectric systems today use this type of control. It is more physiologic and predictable for the client than previously used digital control. Each electrode has a dial that can manually be adjusted to increase or decrease gain for the signal. This allows the therapist to amplify or dampen the strength of the received signal from the muscle contraction to modulate prosthetic output. Changes in the gain may need to be made frequently as the client develops mastery of control and increase muscle strength.

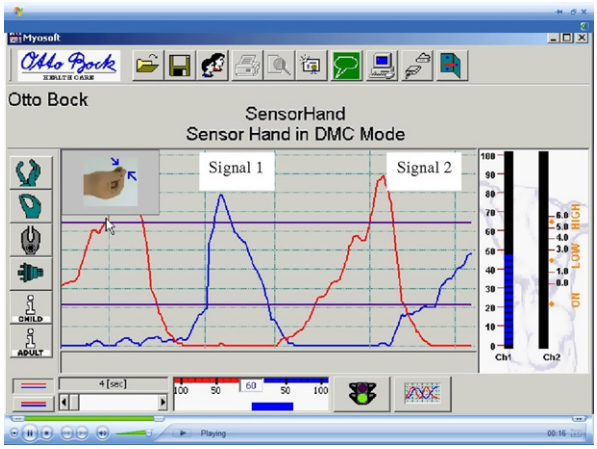

FIGURE 2. *MyoBoy® software (Otto Bock©, Minneapolis, MN) computer screenshot demonstrating a client performing signal separation. For example, signal 1 represents the flexor muscle or the muscles identified to most commonly perform terminal device closing and pronation; signal 2 represents the extensor muscles or the muscles identified to most commonly perform terminal opening and supination. The goal is for the client to be able to activate each muscle signal (1 and 2) separately without co-contracting the other muscle (1 or 2).*

The initial myosite training takes place with the upper extremity in a relaxed position at or near midline. As the client develops control in this plane, introduction of limb placement in various positions is initiated to simulate reaching to heights, across midline, and to the floor. The client's endurance should be considered during initial motor training as the use of an isolated muscle in such a way is foreign and fatiguing. The MyoBoy® software is very motivating for clients. It has programs which use a virtual hand that responds to muscle signal as a myoelectric prothesis would, a car game that uses accuracy and a score for the competitive at heart (see Figures 3A and 3B). The excitement of success and the involvement of competition in the training process are contagious, but must be monitored to prevent fatigue and subsequent increased discomfort.

The electrodes used for the myosite training can be attached to the client's actual TD before fabrication of the preparatory prosthesis (see Figure 4). This step provides three-dimensional perception of the prosthesis. Introduction of the concepts of prepositioning for the most efficient grasp patterns with different shapes of objects and appropriate force control with different densities of objects is effectively introduced during this stage.

The skills and knowledge that the client gains with preprosthetic training are critical to motivation and success with his or her prosthesis. Clients that receive preprosthetic training demonstrate some amount of immediate success at first fitting. This promotes motivation, gain of function in the residual limb, and a preliminary sense that the client will once again have control over his or her life. The earlier the client learns these valuable principles, the easier it is to transition to actual prosthetic use and refrain from poor ergonomic postures leading to cumulative trauma disorders.

Prosthetic Training

A valid question often posed by the upper limb amputee, especially among those who are younger in age, is "Why do I have to wear a prosthesis?" It is true that most unilateral amputees can function independently with the use of one hand. It is also true that the prosthesis will never truly replace the loss of a human limb. Instead, a prosthesis is a primitive facsimile of what was once real, which can be clumsy, uncomfortable, and feel foreign to the wearer. However, with correct skilled prosthetic training the

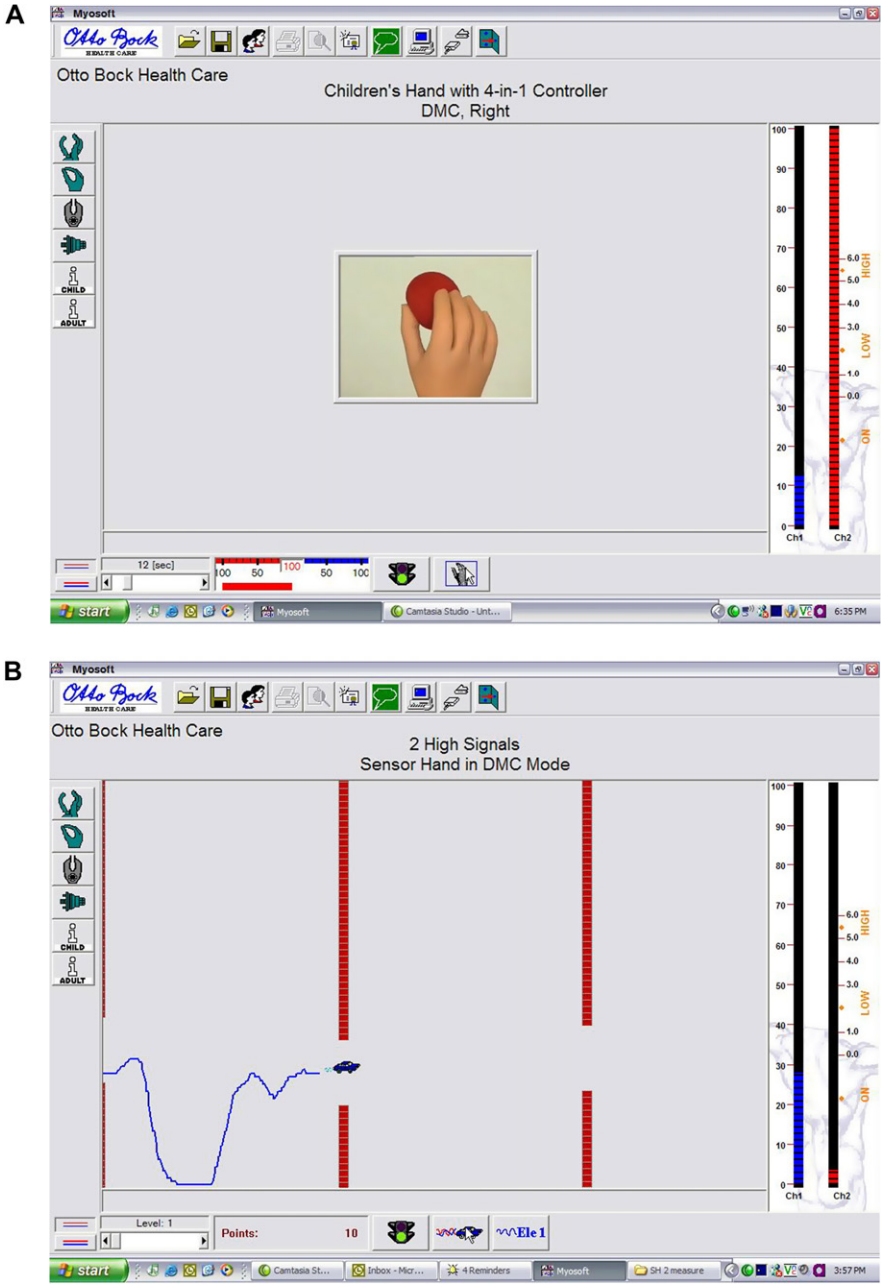

FIGURE 3. *(**A**, **B**)Various games are available on the MyoBoy® software (Otto Bock©, Minneapolis, MN) package. (**A**) The object of the virtual hand game is for the client to exercise the proper force of contraction to grasp and release the ball. (**B**) In this example, the car represents one of the two muscle signals used to control the terminal device (TD). The object of this game is for the client to master accuracy with contraction force and to increase contraction endurance to navigate the car over the wall without crashing. This game can be further graded with the addition of a second simultaneous car representing the opposing muscle used for TD operation.*

improvement in independent functional performance cannot be understated.

This training marks a major turning point in rehabilitative care of the upper limb amputee. The goal is for the prosthesis to become an integrated part of the client's life; therefore, the therapy focus is for the client to master and habituate the mechanical actions required for prosthetic control, integrate the use of the prosthesis in activity performance, and ultimately achieve independence in all activities of daily living. This is achieved through training in the following: knowledge on the operation and performance of the prosthesis; initiation of controls training; and initiation of ADL training.

Service members are provided three different types of prostheses: myoelectric, body powered, and passive (esthetic only). In some cases, clients are fit with a hybrid prosthesis that is part body powered and part myoelectric. Additionally, there are many different basic TD (hook, hand, Greifer) and activity-specific

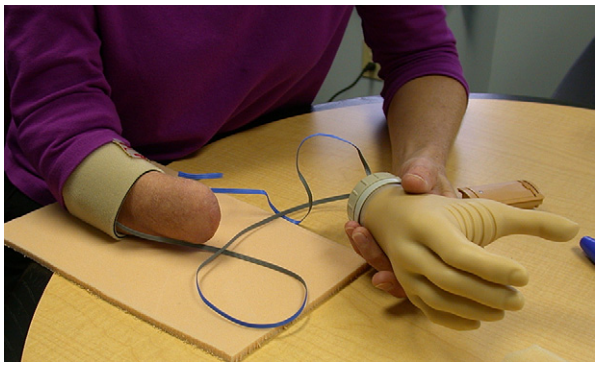

FIGURE 4. *The socket electrodes attached to the actual terminal device (TD) are placed on the corresponding myosites. The client is instructed to activate each muscle to perform the specified TD function. This approach provides three-dimensional, real-time feedback to the client.*

TD that are prescribed to the client. A full explanation is beyond the scope of this article. Clients train on the myoelectric and the body powered and generally self-select one type as their primary or preferred choice. However, many clients will select their prosthesis based on the task at hand, rather than to completely abandon one type of prosthesis altogether. Embedded within the client's selection for body powered versus electric powered, is the question of TD selection. Again, this decision can be task driven and therefore not a one-time decision. It is common to hear a client say that he prefers the myoelectric for one type of activity and the body powered for another task. Here is a nuance in amputee rehabilitation that underscores the importance of the client working diligently with the therapist to train on the various types of TD, and for the client to have a variety of experiences accomplishing many tasks to gauge and refine his skill sets in operation of the different types of prostheses provided.

Operational Knowledge

The client must be able to effectively communicate with the rehabilitation team any mechanical difficulties or operational malfunctions with the prosthesis during the rehabilitation period and when maintenance is required. Common terminology each client should possess includes but is not limited to knowledge of socket and harnessing design, the type of TD(s), and type of control system(s) used by the prosthetic wearer. This education provides the client with basic vocabulary and skills for prosthetic use, maintenance, and the ability to articulate malfunctions using correct terminology which greatly assists the prosthetist in diagnosing and fixing repair issues that arise.

Self-maintenance and Care of the Prosthesis and its Components

Clients are trained to do basic maintenance and repair of the prosthesis in settings where a prosthetist may not be available including socket maintenance, daily cleaning, and inspection of the socket; component maintenance, routine cleaning, and application of lubricant; and harness adjustment and cable system changes, as needed.

Residual Limb Tolerance/Care

With traumatic amputation, the limb continues to heal beneath the surface of the skin well beyond wound closure, which makes the limb more susceptible to pathology. Frequent inspection of the residual limb(s) should become a daily ritual for all prosthetic users. If the skin integrity of the residual limb is compromised, the client's ability to wear the prosthesis is hindered.

Establishing a wearing schedule for the prosthesis is also important. Initially, the prosthesis should be worn for no more than 15 to 30 minutes, two to three times daily. Upon doffing of the prosthesis, the residual limb should be thoroughly inspected for any signs of skin redness, irritation, and/or breakdown. If no signs of ill fit are evident, the user can increase the wearing time by 30-minute increments, two to three times daily. Improper socket fit must be immediately addressed by the prosthetist. The eventual goal is for the prosthetic user to be able to tolerate approximately eight hours of wear and use of the prosthesis within one to two weeks from the start of training.

Inspection of the residual limb should continue to be a daily routine even after the client has progressed to all day wear and use of the prosthesis. Along with limb inspection, proper hygiene of the residual limb is also essential. This includes daily washing of the residual limb with mild soap followed by thorough drying before donning the prosthesis.

Donning/Doffing Prosthesis

Early independence in donning and doffing the prosthesis is important. This includes the residual limb sock, prosthetic donning liner, prosthetic socket, and/or harnessing(s) as applicable. There is a range of different methods for donning/doffing each type of prosthesis. When training the client on donning/doffing of the myoelectric prosthesis, the Reduced Friction Donning System (Advanced Arm Dynamics, Inc., Redondo Beach, CA) is used (see Figures 5A–5C). This prosthetic donning system results in an intimate fit of the residual limb within the socket ensuring optimum electrode contact. When training to don the body-powered prosthesis, the client is instructed in the pullover method, for example, the harness is donned over the head, or the jacket method, for example, the harness is donned over one extremity then the other. Each client is educated in the most appropriate method for them and they may even

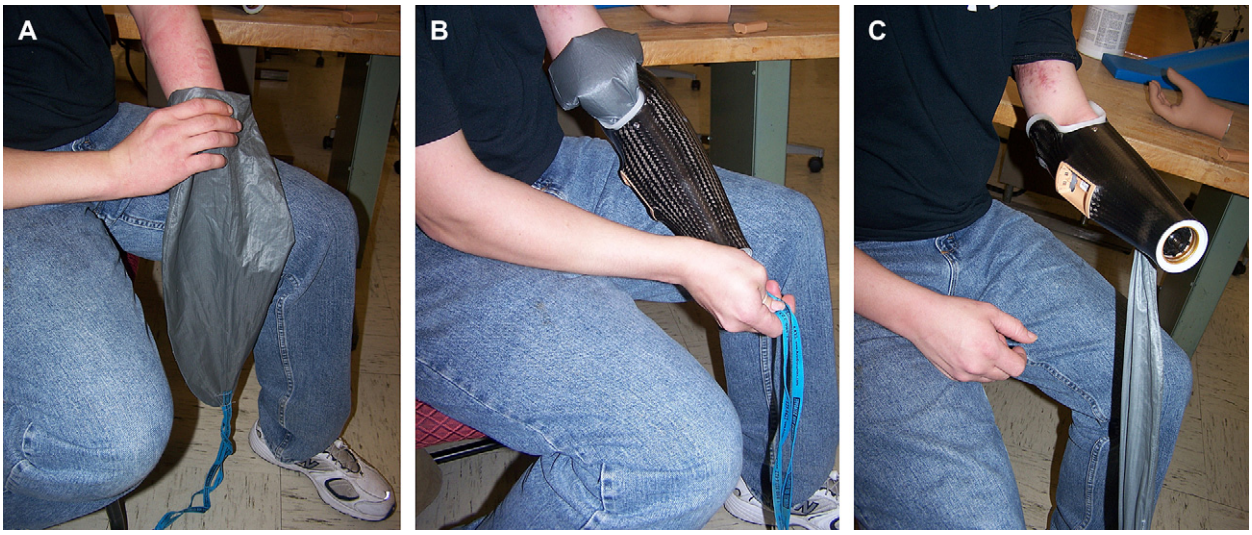

*FIGURE 5. (A–C) The client is trained to don the myoelectric prosthesis with the use of a limited friction donning sock with a lanyard secured to the end. (**A**) The sleeve is inverted over the residual limb. (**B**) The sock-covered limb is placed in the prosthesis. The client places tension on the lanyard to begin to pull the sock through the socket, thus pulling the limb into the socket. (**C**) The sock is pulled through the tube via the lanyard gently bringing the soft tissue into the socket.*

develop their own technique. The methods for donning and doffing the prosthetic system for bilateral amputees vary significantly based on level of amputation. The end goal is for the client to be able to perform this task independently. Additional creativity on the part of the therapist and client is required to achieve this goal.

Initiation of Controls Training

Learning to use a prosthesis is similar to learning the operation of other complex mechanical devices. For example, when beginning to drive, the first step is learning to control the individual components required for operation of the vehicle. This includes turning on and off the vehicle; adjusting the mirrors and seats; and operation of the shifter, gas, and brake. These components are eventually combined into the actual performance of driving a vehicle. Similarly, when an amputee begins his or her prosthetic training, the first step is to learn how to control the individual components to operate the prosthesis. Subsequent steps in the newly learned motor patterns are combined together to accomplish tasks creating a hierarchy of progression through the controls training. The goal is to achieve smooth movement of the prosthesis with minimal amount of delays and awkward motions[11] in daily activity task performance.

The tasks used to achieve mastery of each control skill depend on the creativity of the therapist. Media appropriate for training include objects of various shape, texture, density, and weight, such as one-inch wood square blocks, round blocks, cotton balls, Styrofoam cups, or a cup filled with water. This type of media provides a variety of different ways to grade the task at hand to achieve mastery of control. Initial training is frequently rote in nature however with mastery of each skill, motions are combined together resulting in performance of an activity. A multisensory approach is also useful. Verbal, tactile, and visual cues can be helpful to attain success. The progression through the hierarchy of controls training described by each level of upper extremity amputation is depicted in Figures 6 and 7.

ADL Prosthetic Training

The client is trained to apply the skills learned during the controls training portion to begin actual functional use of the prosthesis. This may cause increased user frustration due to the awkward and artificial nature of a prothesis. Those with unilateral amputation quickly learn to adapt to one-handed task performance, which can become habitual. Rating guides developed by Atkin's titled ''Unilateral Upper Extremity Amputation - Activities of Daily Living'' (see Figure 8) provides a comprehensive list of activities the client should be able to perform with the use of the prosthesis.[12] A rating guide is also available for bilateral upper extremity amputations. It is unreasonable to expect a unilateral amputee to use a prosthesis to the same extent as they spontaneously used the preexisting sound limb. The level of difficulty in training and the amount of training time needed may vary from one prosthetic user to the other.

Advanced Prosthetic Training

The goals of advanced training are for the client to complete basic and advanced daily tasks

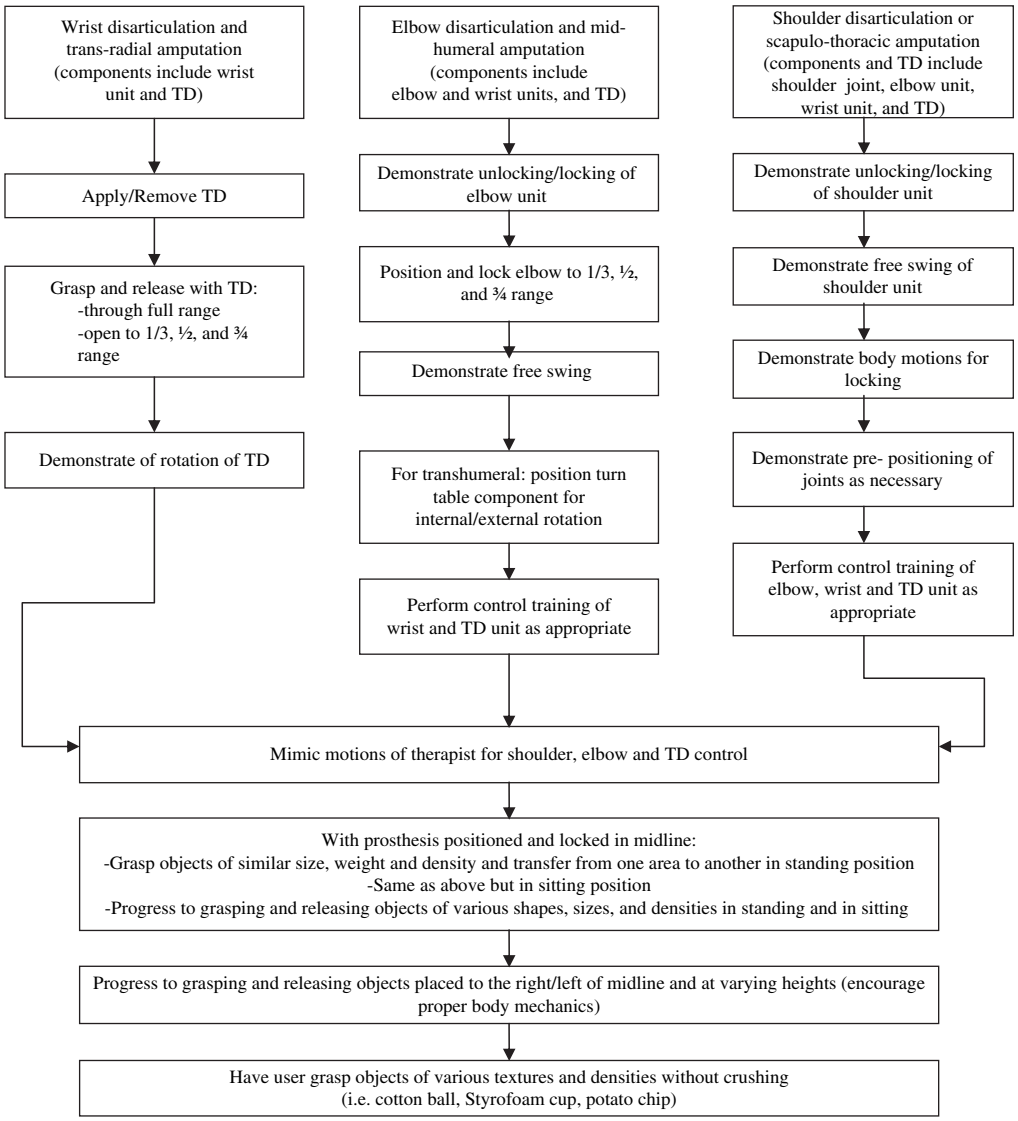

FIGURE 6. *Controls training for body-powered prosthesis by level of amputation.*

incorporating the prosthesis efficiently and demonstrating a natural motor pattern. The outcome of this phase is for the client to save body energy, decrease biomechanical stress to the intact limb, and learn the most efficient approach to tasks without extraneous body movements and the reliance on adaptive equipment.

There are five characteristics of advanced prosthetic rehabilitation that can guide therapists during this phase of training. The first is that advanced rehabilitation is individualized in its very nature. Overall, successful rehabilitation of a client with upper limb amputation involves knowing the whole person and what meaningful occupations they previously selected. When the client progresses to this training, therapy becomes more individualized, incorporating the client's particular vocational and avocational goals. Second, this training requires the use and operation of a tool, or interaction with an object, such as a carpenter's tool, a musical instrument, a cooking utensil, or a machine. The third notable characteristic is that advanced training involves completing a multistepped complex task with many required bimanual movements. Treatment activities in this phase are less static and generally challenge the therapist to take the client out of the clinic setting. The fourth characteristic is that this type of training should involve the prosthesis of choice for the client. The client is encouraged to try different TDs during activity performance to help them decide which device best meets their needs. Whether the client self-selects the myoelectric or body-powered prosthesis as the preferred prosthesis, the advanced training should be geared toward fine-tuning the operation and control of that prosthesis as needed to engage in the appropriate tasks at this level of rehabilitation. The fifth and final characteristic is that there is a meaningful product or outcome upon task completion. For example, the client would have built the frame, weeded the garden, assembled the

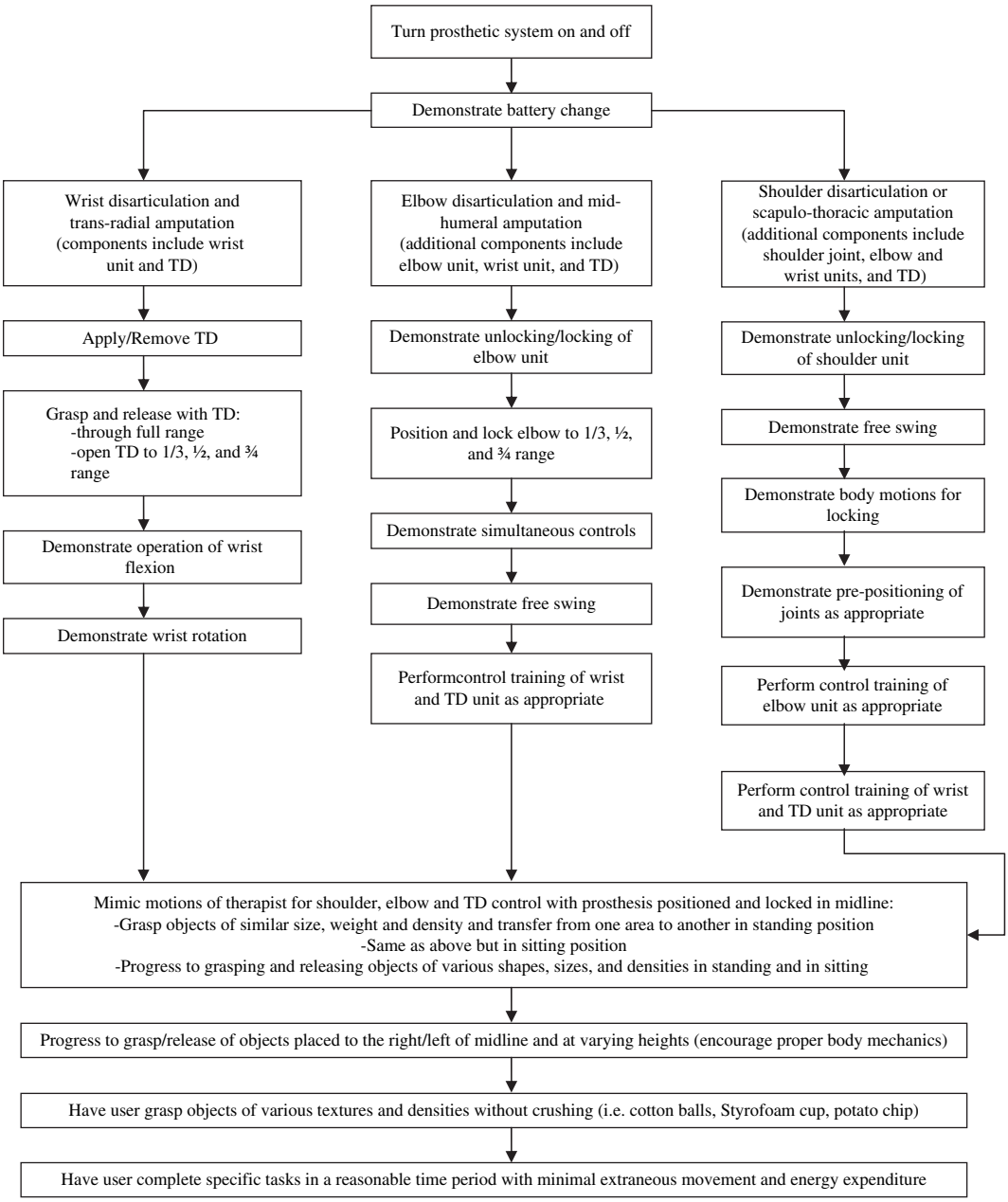

FIGURE 7. *Controls training for myoelectric prosthesis by level of amputation.*

weapon, dug the hole, or repaired the engine. At WRAMC, the clients complete a ''prosthesis thesis'' as a capstone assignment from this phase of training. Several clients have completed carpentry projects, leather belt or wallet projects, and complex stain glass or wood burning crafts.

Ten categories of advanced prosthetic tasks performed at WRAMC and BAMC include military Warrior Tasks; yard work; community reintegration; shopping; driver's training; vocational evaluation and training; recreational and sports activities; child care and/or pet care; home repair and maintenance; and meal preparation. See Table 1 for more details.

Many clients are interested in completing military Warrior tasks as they solidify the client's compromised identity as a Service member. The tasks encompassing this category allow clients who wish to remain on active duty in the military the ability to demonstrate that they can meet the minimum standards of required military skills for military service. Clients in the military who choose to explore options for civilian employment are challenged in the category of vocational evaluation and training. Some military clients have a job history and a college degree that qualifies them for work outside the military; however, many of the young Service members lack the education and training required to perform their preferred line of work in the civilian sector. For example, many military personnel who have worked as mechanics on military vehicles lack

Name:	Age:	Occupation:	Date(s) of Test:
Therapist:	Sex:	Type of terminal device:	

RATING GUIDE KEY:

0 Impossible	1 Accomplished with much strain, or many awkward motions	2 Somewhat labored, or few awkward motions	3 Smooth, minimal amount of delays and awkward motions

ACTIVITIES OF DAILY LIVING	0	1	2	3
PERSONAL NEEDS:				
Don/doff pull-over shirt				
Dress button-down shirt: cuffs and front				
Manage zippers and snaps				
Don/doff pants				
Don/doff belt				
Lace and tie shoes				
Don/doff pantyhose				
Tie a tie				
Don/doff brazier				
Don/doff glove				
Cut and file finger nails				
Polish finger nails				
Screw/unscrew cap of toothpaste tube				
Squeeze toothpaste				
Open top of pill bottle				
Set hair				
Take bill from wallet				
Open pack of cigarettes				
Light a match				
Don/doff prosthesis				
Perform residual limb care				
EATING PROCEDURES:				
Carry a tray				
Cut meat				
Butter bread				
Open Milk Carton				
DESK PROCEDURES:				
Use phone and take notes				
Use pay phone				
Sharpen pencil				
Use scissors				
Use ruler				
Remove and replace ink pen cap				
Fold and seal letter				
Use paper clip				
Use stapler				
Wrap package				
Use computer: typing, access Internet				
Demonstrate handwriting				

COMMENTS:

ACTIVITIES OF DAILY LIVING	0	1	2	3
GENERAL PROCEDURES:				
Turn key in lock				
Operate door knob				
Place chain on chain lock				
Plug cord into wan outlet				
Set time on watch				
HOUSEKEEPING PROCEDURES:				
Perform laundry				
Fold clothes				
Set up ironing board				
Iron clothes				
Hand wash dishes				
Dry dishes with a towel				
Load and unload dishwasher				
Use broom and dustpan				
Operate vacuum cleaner				
Use wet and dry mop				
Make bed				
Change garbage bag				
Open/close jar				
Open lid of can				
Cut vegetables				
Peel vegetables				
Manipulate hot pots				
Thread a needle				
Sew a button				
USE OF TOOLS:				
Saw				
Hammer				
Screw drivers				
Tape measure				
Wrenches				
Power tools: drill, sander				
Plane				
Shovel				
Rake				
Wheel barrel				
CAR PROCEDURES:				
Open and close doors, trunk and hood				
Perform steps required to operate vehicle				

COMMENTS:

FIGURE 8. *The "Unilateral Upper Extremity Amputation: Activities of Daily Living Assessment," is a rating guide that provides a comprehensive list of activities of daily living that a unilateral amputee should be able to accomplish. Adapted with permission from Atkins DJ. In: Atkins DJ, Meier RH, eds. Comprehensive Management of the Upper-Limb Amputee. New York: Springer-Verlag; 1989:49.*

the required education and certification needed to work as a mechanic in the civilian market. This category is crucial in exploring additional vocational options.

Each of the ten categories challenges the client to complete the task successfully with the prosthesis. The client who passes the rigors of this level of training is often identified by the rehabilitation staff

TABLE 1. **Advanced Prosthetic Training Activity Categories**

Task Description	*Key Points or Subtasks*
Military Warrior Tasks: tasks specific to basic Warfighter skills	• assemble and disassemble, fire, repair, and clean a military service weapon • don and doff a gas mask • operate a military radio • assemble a rucksack with all appropriate military gear
Yard Work: tasks require movements in many planes with various tools that require difficult postures and much upper body and trunk muscle strength	• Manipulate garden tools outside of the clinic: o spades o shovels, o hedge clippers o wheelbarrows
Community Re-integration: advanced training in the environment outside the rehabilitation clinic's confines	• visit a mall: o manipulate bills or a credit card from a purse, wallet, or pocket o try on clothes o carry multiple packages
	• negotiate a food court: o carry the tray from the restaurant counter to the table o manage the multiple fine and gross motor tasks of eating o manage to carry the tray to a central garbage receptacle
Shopping	• shop for groceries: o reach packages/items from shelves of variable heights
	• negotiate self-service check-out lanes: o complete tasks related to purchasing, scanning, bagging, and paying for groceries o use the automated credit card machine o use the automated cash machine
	• tasks inherent to shoe and clothes shopping using the preferred prosthesis
Driver's Training	• Referral to a Driving Rehabilitation Specialist for: • driving evaluation • identification of appropriate vehicle modification equipment • training with adaptive driving equipment
Vocational Training: a newly acquired upper limb amputation greatly challenges the client's career direction therefore training is specific to the client's particular occupational pursuit	• spend time helping the client sort out his or her desired vocational pursuit • customize a treatment plan that address the specific task demands of the various occupations of interest
Recreation and Sports Activities: many customized prostheses and TDs are available on the commercial market to facilitate the return to previously enjoyable activities	• review the clients "hobby history" • explore available activity-specific TDs • train the client in use of the activity-specific TD
Child Care and Pet Care: the tasks and responsibilities in the category of child and pet care are many, changing, and quite varied	• therapist must perform careful task analysis of each task • use of therapy pets to make training in pet care quite realistic • address child care training as it relates to the specifics of the client's own children o use a doll to practice the skills of diapering, holding, bathing, and swaddling with prosthesis
Home Repair and Maintenance: the client identifies his or her previous home responsibilities, or predicts those of their future	• perform simulated tasks in a functional apartment to include: o take out the garbage o fix a leaky sink o change the sheets on the bed o run the vacuum o unload groceries into the pantry o replace the shower curtain liner in the bathroom
	• additional practice of "real-life" chores, as necessary
Meal Preparation: completion of this high level training gives the client a sense of accomplishment and a strong sense of independence	• participate in a weekly cooking group and complete the entire meal preparation process: o cook o serve o clean up
	• exposure to one-handed adaptive kitchen aids

as ''integrator'' because of his or her success at integrating the prosthesis into his or her motor skill repertoire, thereby attaining the goal of this phase of rehabilitation. Overall, the client's movements should be coordinated, smooth, and precise with accurate and consistent control of the operations of his or her prosthesis using ergonomically sound postures proximally.

It is important to note that each phase of rehabilitation is repeated with additional prosthesis as appropriate. With training of subsequent prosthetic use, the client's ability to master the foundational skills and perform functional tasks is rapid.

LONG-TERM DISCHARGE PLANNING

The discharge planning phase of the protocol begins on the day the rehabilitation team is introduced to the injured client. As would be true with civilian clients undergoing rehabilitation, the information that is gathered during the initial evaluation serves as the foundation for the discharge planning process. The intent of a discharge plan is to provide a smooth transition from one level of care to another level of care.

Discharge planning is a process that is best performed by a multidisciplinary team, along with the client and the client's family. At WRAMC and BAMC, the medical members of this team consist of a physiatrist who acts as coordinator for medical and surgical subspecialists, nurses, occupational and physical therapists, prosthetists, social workers, psychologists, dieticians, pharmacists, and psychiatrist. This group also includes a Physical Evaluation Board Liaison Officer and a Veterans Affair (VA) counselor to assist with the military medical disability system. This team meets on a weekly basis through team conferences and outpatient amputee clinics. These meetings ensure communication among the team, and quality and efficient care for every client. In the civilian sector, a client will typically be discharged from the hospital to a subacute rehabilitation facility or to home.

Preinjury Status

Understanding the client's lifestyle before admission will give insight into possible future goals. Knowledge about the clients's preexisting family/support system, physical condition, emotional/cognitive status, educational level, vocation, and avocations cannot be understated. The client's culture and primary language, if other than English, will impact discharge planning as well.

Postinjury Physical Status

Ongoing medical care for combat wounded amputees at a minimum will include regular follow-ups with a physiatrist who will act as a coordinator for any specialty care required. Depending on the client's duty status and medical care choices, he or she will receive care at a military hospital, a Veteran's Administration hospital, or through a TriCare military health system provider.

Current Status

As the client becomes medically stable and maximizes therapy services, a reevaluation of his or her current physical, cognitive, and emotional status will provide information necessary to guide proposals for the appropriate living situation and referrals to other agencies. This information directs recommendations for transition to a safe level of care. Referrals for equipment, home health, and transportation needs are made based on these recommendations. Results of vocational testing will direct further training or job placement.

Community Reintegration

The experiences that the clients have during community outings assist in identifying other possible needs as they transition away from the hospital campus. No matter how well a client is prepared for interactions in the community, the demands of the community cannot be recreated with the walls of the clinic. Experiences in the community are invaluable for the client. A challenging first experience without support can result in a major setback, whereas a positive, supported first experience typically leads to more of the same.

Resources

Providing the client with resources to support the rehabilitation that he or she received is critical. Rehabilitation is provided to persons who have undergone a life-altering event. This rehabilitation is a very turbulent time; however, those in the program experience new life in a protected environment with significant support systems in place. Transitions to different levels of care outside of this support system bring with them new stresses, which frequently go understated in the discharge planning process. Often these emotions are not recognized by the client until the transition has occurred. In preparation for discharge and to reduce the feelings of isolation, those receiving care at WRAMC and BAMC are introduced to numerous resources by multiple members of the rehabilitation team.

RECENT ADVANCEMENTS IN PROSTHETIC DEVELOPMENT

Although it has been acknowledged that a prosthetic limb does not provide all of the preamputation

functionality of a human limb, there have been many recent advances to improve upper limb prosthetic restoration. These advances can be categorized as follows: prosthetic interface, microprocessor technology, TDs, and treatment protocols.

Prosthetic Interface

Comfort for the client has been enhanced by improved socket design. This includes development of suction silicone roll-on liners, which decrease the need for harnessing; flexible sockets that improve force distribution; and anatomically contoured sockets for improved prosthetic fit.[12–15]

Microprocessor Technology

Microprocessors provide customization for individual control inputs and thresholds in the electric prostheses. This improves the responsiveness of the prosthesis for each client.[16]

Terminal Devices

Terminal devices for electric systems have seen the greatest changes. Water resistant TDs are now available allowing function in a greater diversity of environments. An increase in the speed of certain TDs has dramatically impacted the function and satisfaction of clients with electric systems as the prosthesis output is more ''real time.'' Additionally, functional prosthetic devices for partial hand amputees have been developed to provide another option to the passive prosthesis for this population.[16]

Treatment Protocols

In the 1980s, Malone et al.[9] demonstrated that clients fit with a prosthesis within 30 days had higher rehabilitation success. This was supported by Fletchall's work evaluating ''the value of specialized rehabilitation of trauma and amputation'' in 2005.[17] With this knowledge, it is hopeful that the future standard of care for the upper limb amputee will include immediate treatment by a specialized upper extremity team using a client-centered approach to rehabilitation to maximize function.

Although engineering and electronic developments for the mass market continue to influence prosthetic technology development, there has been a significant increase in support that is specifically targeted at development of upper limb prosthetic technology from federal and military sources. Currently sponsored projects by Defense Advanced Research Projects Agency (Arlington, VA) are examples of this type of development. Some of the two- to five-year goals for these projects include local control, state sensing, and task-based mode shifting within the device to enable improved functionality; simultaneous function of three to five joints; increased degrees of freedom for the wrist and hand; a minimum of three to five grasp patterns; fingertip force detection; increased elbow lift strength; and increased wrist flexion strength.[18]

CONCLUSION

Providing an environment to try previous activities or new challenges can lead to some of the most rewarding experiences. At both WRAMC and BAMC, there are a wide variety of activities available with support for the Service member to experience before leaving the hospital. The athletic activities have been some of the most popular. Members of the armed forces are young, athletic, and competitive, so harnessing this desire has been incredibly successful. The programs available include snow skiing, water skiing, rafting and kayaking, hunting and shooting, and rock climbing to mention a few. Providing resources and contacts to enable the client to pursue or continue with new activities in their home community can be a critical component to full reintegration.

Life is forever changing and challenging. Providing dynamic and supportive skilled upper extremity limb loss rehabilitation in a comprehensive method beginning with the medical model and progressing to an occupation-based model in a controlled living environment and community provides the client with a solid foundation to approach their changed life with its new challenges upon discharge. The upper extremity amputee rehabilitation efforts at WRAMC and BAMC are designed to provide clients with fundamental upper extremity prosthetic skills to live balanced, filled, and productive lives both in and out of the military system with a prosthesis(es). Efforts are underway to research the qualitative outcomes of upper extremity amputees to include their occupational outcomes, their perceived quality of life, and their continued use of the upper extremity prosthesis(es).

Additional information on management and rehabilitation of the upper extremity amputee can be found in Textbook of Military Medicine, Care of the Combat Amputee.

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REFERENCES

1. Dillingham TR. Rehabilitation of the upper limb amputee. In: Dillingham TR, Belandres PV (eds). Textbook of Military

Medicine Part Iv Surgical Combat Casualty Care: Rehabilitation of the Injured Combatant, Vol. 1. Washington, DC: Office of The Surgeon General at TMM publications, 1998, pp 33–77.
2. Walter Reed Amputee Care Program Database. Washington, DC: Military Amputee Care Program, 2003. Updated Jan 18, 2007.
3. Atroshi I, Rosberg HE. Epidemiology of amputations and severe injuries of the hand. Hand Clin. 2001;17:343–50.
4. Huston C, Dillingham TR, Esquenazi A. Rehabilitation of the lower extremity amputee. In: Dillingham TR, Belandres PV (eds). Textbook of Military Medicine Part IV Surgical Combat Casualty Care: Rehabilitation of the Injured Combatant, Vol. 1. Washington, DC: Office of The Surgeon General at TMM publications, 1998, pp 79–159.
5. Jefferies GE. Pain management: post-amputation pain [serial online]inMotion. 1998;8:2, Available at: Amputee Coalition of America, Knoxville, TN. Accessed Jan 13, 2007.
6. Ramachandran VS, Hirstein W. The perception of phantom limbs: the D.O. Hebb Lecture. Brain. 1998;121(Pt 9):1603–30.
7. Ramachandran VS, Rogers-Ramachandran D. Synaesthesia in phantom limbs induced with mirrors. Proc Biol Sci. 1996; 263(No.1369):377–86.
8. Jones LE, Davidson JH. Save that arm: a study of problems in the remaining arm of unilateral upper limb amputees. Prosthet Orthot Int. 1999;23(1):55–8.
9. Malone JM, Fleming LL, Roberson J, Whitesides TE, Leal JM, Poole JU, Sternstein-Grodin R. Immediate, early, and late post-surgical management of upper-limb amputation. J Rehabil Res Dev. 1984;21:33–41.
10. Bowker JH. The art of prosthesis prescription. In: Smith DG, Michael JW, Bowker JH (eds). Atlas of Amputations and Limb Deficiencies. Rosemont, IL: American Academy of Orthopaedic Surgeons, 2004, pp 742.
11. Atkins JD, Meier RH (eds). Comprehensive Management of the Upper-Limb Amputee. New York: Springer-Verlag, 1989, pp 48.
12. Lake C. Partial hand amputation: prosthetic management. In: Smith DG, Michael JW, Bowker JH (eds). Atlas of Amputations and Limb Deficiencies—Surgical, Prosthetic and Rehabilitation Principles. 3rd ed. Rosemont, IL: American Academy of Orthopedic Surgeons, 2004, pp 209–17.
13. Miguelez JM, Lake C, Conyers D, Zenie J. The transradial anatomically contoured (TRAC) interface: design principles and methodology. J Prosthet Orthot. 2003;15:148–56.
14. Miguelez JM, Miguelez MD. The microframe: the next generation of interface design for glenohumeral disarticulation and associated levels of limb deficiency. J Prosthet Orthot. 2003; 15:66–71.
15. Lake C, Dodson R. Progressive upper limb prosthetics. Phys Med Rehabil Clin N Am. 2006;17:49–72.
16. Lake C, Miguelez J. Comparative analysis of microprocessors in upper limb prosthetics. J Prosthet Orthot. 2003;15: 48–63.
17. Fletchall S. Returning upper-extremity amputees to work. The O&P Edge. 2005;4:28–33, [serial online] Available at: http://www.oandp.com/edge/issues/articles/2005-08_04.asp. Accessed Feb 13, 2007.
18. Ling G. Prosthesis 2007 [proposal]. Defense Advanced Research Projects Agency [serial online]. Available at: http://www.darpa.mil/baa/baa05-19mod5.htm. Accessed Feb 13, 2007.

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#1. As of the writing of this article how many upper limb amputees have returned to active duty?
   a. 50
   b. 25
   c. 10
   d. 1

#2. The vast majority of the prosthetic rehabilitation for service personnel takes place at
   a. Brooke Army and Walter Reed Medical Centers
   b. MASH units
   c. Army field hospitals
   d. Valley Forge Army Hospital

#3. Goals for training the military amputees are directed at anticipated eventual return to
   a. primarily military functions
   b. primarily civilian functions
   c. social acceptance of the prosthesis
   d. civilian and military functions

#4. The nature of most of the combat injuries that result in eventual amputation of the upper limb produce
   a. sharp lacerations at the level of the amputation
   b. grossly infected wounds
   c. potentially contaminated wounds
   d. concomitant head injuries

#5. Almost all the interventions described for a military amputee's rehabilitation can be applied to the typical civilian amputee population
   a. true
   b. false

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