Clinical Policy Bulletin: Myoelectric Upper Limb Prostheses

Number: 0399

Policy

Aetna considers myoelectric upper limb prostheses and hand prostheses (e.g., the Dynamic Mode Control hand, the i-LIMB, the Liberty Mutual Boston Elbow prosthetic device, the LTI Boston Digital Arm System, the Otto Bock System Electrohand, and the Utah Elbow System) medically necessary for members with traumatic amputation or congenital absence of upper limb at the wrist or above (e.g., forearm or elbow) when the following criteria are met:

- Person has adequate cognitive ability to utilize a myoelectric prosthetic device; and
- The remaining musculature of the arm(s) contains the minimum microvolt threshold to allow operation of a myoelectric prosthetic device; and
- A standard body-powered prosthetic device can not be used or is insufficient to meet the functional needs of the person in performing activities of daily living.

Aetna considers myoelectric upper limb and hand prostheses experimental and investigational for all other indications because their effectiveness for indications other than the ones listed above has not been established.

Aetna considers partial-hand myoelectric prostheses (e.g., ProDigits) experimental and investigational because their effectiveness has not been established.

Aetna considers transcranial direct current stimulation for enhancing performance of myoelectric prostheses experimental and investigational because of insufficient evidence.

For myoelectric prostheses of the lower extremity see CPB 0578 - Lower Limb Prostheses.

Background
The myoelectric hand prosthesis is an alternative to conventional hook prostheses for patients with traumatic or congenital absence of forearm(s) and hand(s). The myoelectric prostheses are user controlled by contraction of specific muscles triggering prosthesis movement through electromyographic (EMG) signals. These prostheses have a stronger pinch force, better grip, and are more flexible and easier to use than conventional hooks.

Myoelectric control is used to operate electric motor-driven hands, wrist, and elbows. Surface electrodes embedded in the prosthesis socket make contact with the skin and detect and amplify muscle action potentials from voluntarily contracting muscle in the residual limb. The amplified electrical signal turns on an electric motor to provide a function (e.g., terminal device operation, wrist rotation, elbow flexion). The newest electronic control systems perform multiple functions, and allow for sequential operation of elbow motion, wrist rotation and hand motions.

Myoelectric hand prostheses provide improved function and range of functional position as compared to “hook” prostheses. Myoelectrical hand prostheses can be used for patients with congenital limb deficiencies and for patients with amputations sustained as a result of trauma or surgery. The device is appropriate for both above-the-elbow and below-the-elbow amputees, and for both unilateral and bilateral amputees. Patients must possess a minimum microvolt threshold (i.e., minimum strength of microvolt signals emitting from the remaining musculature of the arm) and pass a control test to be considered a candidate.

Myoelectrical hand prostheses are indicated for persons at least 1 year of age or older. Children with congenital absence of the forearm(s) and hand(s) are usually fitted with a conventional passive prosthesis until approximately age 12 to 16 months, at which time they may be fitted with a myoelectrical prosthesis.

Myoelectrical hand prostheses generally come with a 1-year warranty for parts and labor. The motor and drive mechanisms typically last 2 to 3 years and may need to be replaced after this period. When used on a child, the sockets may need to be replaced every 12 to 18 months due to growth. With heavy use the entire prosthesis might require replacement by the 5th year.

The Work Loss Data Institute's clinical guideline on "Shoulder (acute & chronic)" (2011) listed myoelectric upper extremity (hand and/or arm) prosthesis as one of the interventions/procedures that were considered and recommended.

Ostlie and colleagues (2012) described patterns of prosthesis wear, perceived prosthetic usefulness, as well as the actual use of prostheses in the performance of activities of daily life (ADL) tasks in adult acquired upper-limb amputees (ULAs). Cross-sectional study analyzing population-based questionnaire data (n = 224) and data from interviews and clinical testing in a referred/convenience sample of prosthesis-wearing ULAs (n = 50). Effects were analyzed using linear regression; 80.8 % wore prostheses and 90.3 % reported their most worn prosthesis as useful. Prosthetic usefulness profiles varied with prosthetic type. Despite demonstrating good prosthetic skills, the amputees reported actual prosthesis use in only about 50 % of the ADL tasks performed in everyday life. In unilateral amputees, increased actual use was associated with sufficient prosthetic
training and with the use of myoelectric versus cosmetic prostheses, regardless of amputation level. Prosthetic skills did not affect actual prosthesis use. No background factors showed significant effect on prosthetic skills. The authors concluded that most major ULAs wear prostheses. They stated that individualized prosthetic training and fitting of myoelectric rather than passive prostheses may increase actual prosthesis use in ADL.

There are many brands of myoelectric hand prostheses on the market. Brands of myoelectrical hand prostheses include the Otto Bock myoelectrical prosthesis (Otto Bock, Minneapolis, MN), the Liberty Mutual Boston Elbow prosthetic device (Liberty Mutual, Boston, MA), and the Utah Elbow System (Motion Control, Salt Lake City, UT).

Partial-hand myoelectric prostheses are designed to replace the function of digits in individuals missing 1 or more fingers as a result of a partial-hand amputation. This type of prosthetic device requires a very specific range of amputation, i.e., amputation level through, or just proximal to, the metacarpal-phalangeal level of 1 or more digits.

Putzi (1992) reported the case of a young man who had 2 traumatic amputations and burns covering 80% of his body. Due to his severe burns, fitting a conventional prosthesis was a problem because normal procedures did not apply in his case. The patient was fitted with a myoelectric partial-hand prosthesis. The author concluded that this reconstruction of the myoelectric prosthesis was a satisfactory solution in providing the patient with as much hand and arm mobility as possible in light of his condition. By using basic principles of orthotics and prosthetics, and exercising ingenuity in using existing proven components, it is possible to provide improvement in function and cosmetics to an individual with a partial-hand amputation.

Lake (2009) provided a review of progressive partial-hand prosthetic management. The author noted that partial-hand prosthetic management represents an exciting new frontier in the specialty of upper limb prosthetics. The application and benefit of treating this level are apparent. Presently, this level is very difficult because of the vast surgical presentations, traumatic nature of the resultant limb difference, as well as the complicated biomechanics present as a result of the afore-mentioned 2 issues. Lake (2009) noted that electric prosthetic management requires specialized care that does not have its foundation rooted in any of the current, yet progressive upper limb care protocols used by today's specialists. Future research will entail electronic handling, fabrication, fitting protocols and techniques, as well as surgical considerations. As fitting techniques and componentry evolve, so will the clinical protocols. The author stated that an unique opportunity exists at the partial-hand level as this specialty enters a new prosthetic paradigm where evidence-based rehabilitation and sound research practices are expected by both the medical community as well as reimbursement agencies.

Currently, there is insufficient peer-reviewed evidence that examined the clinical value (e.g., improved function and health-related quality of life) of partial-hand myoelectric prostheses.
Dutta et al (2014) noted that functional electrical stimulation (FES) can electrically activate paretic muscles to assist movement for post-stroke neurorehabilitation. Here, sensory-motor integration may be facilitated by triggering FES with residual EMG activity. However, muscle activity following stroke often suffers from delays in initiation and termination which may be alleviated with an adjuvant treatment at the central nervous system (CNS) level with transcranial direct current stimulation (tDCS) thereby facilitating re-learning and retaining of normative muscle activation patterns. This study on 12 healthy volunteers was conducted to investigate the effects of anodal tDCS of the primary motor cortex (M1) and cerebellum on latencies during isometric contraction of tibialis anterior (TA) muscle for myoelectric visual pursuit with quick initiation/termination of muscle activation, i.e., “ballistic EMG control” as well as modulation of EMG for “proportional EMG control”. The normalized delay in initiation and termination of muscle activity during post-intervention “ballistic EMG control” trials showed a significant main effect of the anodal tDCS target: cerebellar, M1, sham (F(2) = 2.33, p < 0.1), and interaction effect between tDCS target and step-response type: initiation/termination of muscle activation (F(2) = 62.75, p < 0.001), but no significant effect for the step-response type (F(1) = 0.03, p = 0.87). The post-intervention population marginal means during “ballistic EMG control” showed 2 important findings at 95% confidence interval [critical values from Scheffe’s S procedure]: (i) Offline cerebellar anodal tDCS increased the delay in initiation of TA contraction while M1 anodal tDCS decreased the same when compared to sham tDCS; and (ii) Offline M1 anodal tDCS increased the delay in termination of TA contraction when compared to cerebellar anodal tDCS or sham tDCS. Moreover, online cerebellar anodal tDCS decreased the learning rate during “proportional EMG control” when compared to M1 anodal and sham tDCS. The authors concluded that these preliminary findings from healthy subjects showed specific, and at least partially antagonistic effects, of M1 and cerebellar anodal tDCS on motor performance during myoelectric control. They stated that these results are encouraging, but further studies are needed to better define how tDCS over particular regions of the cerebellum may facilitate learning of myoelectric control for brain machine interfaces.

Pan et al (2015) stated that most prosthetic myoelectric control studies have shown good performance for unimpaired subjects. However, performance is generally unacceptable for amputees. The primary problem is the poor quality of EMG signals of amputees compared with healthy individuals. To improve clinical performance of myoelectric control, these researchers explored tDCS to modulate brain activity and enhance EMG quality. These investigators tested 6 unilateral transradial amputees by applying active and sham anodal tDCS separately on 2 different days. Surface EMG signals were acquired from the affected and intact sides for eleven hand and wrist motions in the pre-tDCS and post-tDCS sessions. Auto-regression (AR) coefficients and linear discriminant analysis (LDA) classifiers were used to process the EMG data for pattern recognition of the 11 motions. For the affected side, active anodal tDCS significantly reduced the average classification error rate (CER) by 10.1%, while sham tDCS had no such effect. For the intact side, the average CER did not change on the day of sham tDCS but increased on the day of active tDCS. The authors concluded that these findings demonstrated that tDCS could modulate brain function and improve EMG-based classification performance for amputees. They stated that it has great
potential in dramatically reducing the length of learning process of amputees for effectively using myoelectrically-controlled multi-functional prostheses.

CPT Codes / HCPCS Codes / ICD-9 Codes

Other CPT codes related to the CPB:

24900 - Surgical amputation, upper extremity
24935, 25900
- 25931,
26910 -
29652

HCPCS codes covered if selection criteria are met:

L6629 Upper extremity addition, quick disconnect lamination collar with coupling piece, Otto Bock or equal
L6632 Upper extremity addition, latex suspension sleeve, each
L6680 Upper extremity addition, test socket, wrist disarticulation or below elbow
L6687 Upper extremity addition, frame type socket, below elbow or wrist disarticulation
L6810 Addition to terminal device, precision pinch device
L6880 Electric hand, switch or myoelectric controlled, independently articulating digits, any grasp pattern or combination of grasp patterns, includes motor(s)
L6882 Microprocessor control feature, addition to upper limb prosthetic terminal device
L6890 Addition to upper extremity prosthesis, glove for terminal device, any material, prefabricated, includes fitting and adjustment
L6925 Wrist disarticulation, external power, self-suspended inner socket, removable forearm shell, Otto Bock or equal electrodes, cables, two batteries and one charger, myoelectronic control of terminal device
L6935 Below elbow, external power, self-suspended inner socket, removable forearm shell, Otto Bock or equal electrodes, cables, two batteries and one charger, myoelectronic control of terminal device
L6945 Elbow disarticulation, external power, molded inner socket, removable humeral shell, outside locking hinges, forearm, Otto
Bock or equal electrodes, cables, two batteries and one charger, myoelectronic control of terminal device

L6955  Above elbow, external power, molded inner socket, removable humeral shell, internal locking elbow, forearm, Otto Bock or equal electrodes, cables, two batteries and one charger, myoelectronic control of terminal device

L6965  Shoulder disarticulation, external power, molded inner socket, removable shoulder shell, shoulder bulkhead, humeral section, mechanical elbow, forearm, Otto Bock or equal electrodes, cables, two batteries and one charger, myoelectronic control of terminal device

L6975  Interscapular-thoracic, external power, molded inner socket, removable shoulder shell, shoulder bulkhead, humeral section, mechanical elbow, forearm, Otto Bock or equal electrodes, cables, two batteries and one charger, myoelectronic control of terminal device

L7259  Electronic wrist rotator, any type

L7368  Lithium ion battery charger, replacement only

L7400  Addition to upper extremity prosthesis, below elbow/wrist disarticulation, ultralight material (titanium, carbon fiber or equal)

L7403  Addition to upper extremity prosthesis, below elbow/wrist disarticulation, acrylic material

L8465  Prosthetic shrinker, upper limb, each

**HCPCS codes not covered for indications listed in the CPB:**

L6026  Transcarpal/metacarpal or partial hand disarticulation prosthesis, external power, self-suspended, inner socket with removable forearm section, electrodes and cables, two batteries, charger, myoelectric control of terminal device, excludes terminal device(s)

**ICD-9 codes covered if selection criteria are met:**

755.20  Reduction deformities of upper limb
755.29

887.0 - 887.7  Traumatic amputation of arm and hand (complete) (partial)

V49.60 - V49.67  Upper limb amputation status

The above policy is based on the following references:


