Most certified prosthetists have a firm understanding of what is needed to achieve optimal outcomes for lower-limb prosthetics patients. We are skilled at recognizing muscle weakness and other issues that may hinder our patients’ proper ambulation. We know how to test their muscle strength and contracture levels and when to refer them to physical therapy to address deficiencies prior to prosthetics management. This is largely because the average prosthetist works with lower-limb prosthetics patients every day. Conversely, the average clinician treats only a few patients with upper-limb amputations per year, and even fewer who use myoelectric upper-limb prostheses. Therefore, the knowledge needed to treat these patients effectively may not be as common.

This article aims to provide clinicians with insight on how to properly evaluate and train upper-limb myoelectric device users to achieve optimum function of their prostheses.

To evaluate and train a candidate for myoelectric control of a prosthesis, such as the RSL Steeper bebionic3 hand, the clinician will need a myoelectric testing device first and foremost. There are many types currently available from a variety of manufacturers. Some are standalone testers, like the Motion Control Myolab, which is a basic device with its own preamp electrodes. Other testers are integrated into the myoelectric arm’s software, such as RSL Steeper’s bebalance software for the bebionic3. With many software-integrated testers, the computer receives the signal from the electrodes, which are placed on the patient’s residual limb or mounted in the prosthetic test socket. Alternatively, the hand could be set up on a demonstration tower or jig during the patient’s testing and training.

Myoelectric testers, both standalone and software integrated, allow the clinician to view, evaluate and document the strength and quality of the EMG signal produced by the patient. This is a vital part of the documentation and justification process as it allows the clinician to track the patient’s ability to use the myoelectric arm and how he or she progresses in that use.

When using a myoelectric testing device, it is also important that the clinician knows and understands the signal requirements of the prosthesis that he or she plans to fit. Does the prosthesis have a full proportional control strategy or an alternate control strategy? Will the patient need to switch between devices, such as from a wrist to a terminal device, or to “trigger” different grip patterns? These factors may require patient control that exceeds a simple, short open/close signal.

A patient’s specific myoelectric signal quality and upper-body strength may seem adequate when operating the device during initial myoelectric testing and while seated at a table in the clinician’s facility. However, by evaluating the patient as he or she performs additional, more specific exercises, the clinician may discover muscle weaknesses and/or muscle or signal fatigue issues that were not realized during the initial testing. Continuing these exercises throughout the pre-prosthetic phase, between initial casting and final delivery of the prosthesis, has been shown to improve the user’s control and functional quality of the device.

There are specific occupational therapy exercises that are designed to help prepare patients for myoelectric prosthetic utilization. They focus on developing strong quality control of myoelectric signals throughout the patient’s full range.
of motion (ROM), increasing muscle/myoelectric signal tolerance against fatigue and conditioning the patient’s overall upper-body strength. It is best that the clinician administer the exercises and testing with the assistance of an occupational therapist (OT). However, it is not required that the OT have extensive experience with upper-limb myoelectric prosthetic devices like the bebionic3. The only necessary aids are standard therapy exercise weights and a myoelectric tester or the tester that is integrated into the myoelectric arm’s software, such as the bebionic bebalance (provided by the clinician).

The OT is well-suited to evaluate the patient’s upper-body conditioning, set up ROM and strength exercises and monitor and document the patient’s progress. During the pre-fitting period, it is also beneficial for the OT to assess the activities of daily living (ADLs) that the patient requires but currently cannot perform without difficulty or without a prosthesis.

Myoelectric pre-fitting occupational therapy exercises consist of progressive sets and/or repetitions, much like one would perform for other physical exercises. One example of an occupational therapy pre-fitting exercise begins with the OT or clinician identifying the patient’s optimal myoelectric site(s) that produces the strongest achievable signal strength without straining the muscle. The clinician/OT then places the electrodes on the residual limb and has the patient operate these electrode site(s) for a certain number of repetitions, or hold signals for a certain number of seconds, while the clinician/OT checks the signal quality and strength. The clinician/OT then slightly reduces the gain settings of the electrodes and, with no rest between sets, has the patient attempt to achieve the same signal strength by performing the same action. Other occupational therapy exercises continue the use of a myoelectric testing device or software and add the use of weights, work through ROM and help build overall upper-body strength. In these exercises, the patient will rest the involved muscle(s) between sets, during which time the OT can begin assessing the patient for his or her required ADLs and set up the next exercises.

The myoelectric pre-fitting occupational therapy exercise program is designed to be completed within a one-hour appointment. It is recommended that the patient visit the clinician’s or OT’s facility to undergo this program two to three times per week for one to four weeks. The number and duration of visits needed will depend on the patient’s abilities and prosthetic demands.

Waiting until the delivery of the final prosthesis to address the issues of patient strength, ROM and strength and quality of myoelectric signals can make the post-fitting stage an aggravating process for the patient, OT and treating prosthetist. When the patient completes a myoelectric occupational therapy exercise program to address these issues in the pre-fitting stage, he or she can begin learning to perform ADLs immediately following the delivery of the prosthesis.

Sam Brouillette, CP, CFo, has more than 21 years of experience in the orthotics and prosthetics (O&P) profession. He was employed for 18 years by an independent O&P patient care facility in North Carolina. In 2010, he joined the SPS Clinical Services Team and now provides seminars, education and one-on-one product training to hundreds of O&P professionals.

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