TRS PROSTHETIC SIMULATOR INSTRUCTIONS

Introduction

The TRS Prosthetics Simulator is the first "standardized" simulator technology ever made commercially available. It features an EXOS® low temperature, thermo-formable body and frame, BOA® cable closure technology and TRS Sure-Lok Cable locking technology, a Hosmer® 5XA V/O Split Hook and a TRS V/C GRIP3®, as well as a fully adjustable Northwestern Figure #9 Harness and cable system.

Custom Form Fitting the Simulator

The TRS Simulator will immediately fit a wide variety of arm sizes because of its flexible materials and BOA closure system but is designed to be able to be custom molded to the evaluator's arm for a precise fit if that is desired. A precise fit may be important if the Simulator is being used for research purposes to ensure that intimate contact occurs resulting in optimal, operational proprioception.

Place the Simulator body without the terminal devices or harness attached and with the BOA system loosened* in an oven set at 130 degrees to 150 degrees Fahrenheit for approximately 10 minutes until the material is soft and flexible.

PLEASE NEVER EXPOSE THE SIMULATOR TO TEMPERATURES THAT EXCEED 150 DEGREES!

* Loosen the BOA cable closure by pulling upwards on the knob away from the simulator body, then grasp the small handle-yoke on the cable and pull out several inches of loose cable allowing the Simulator closure to loosen up along its entire length. *Push in the knob and turn the knob clockwise (Right) to tighten the cable system back up when fitting on a user. The Velco® closure tab can also be opened to release the cable system and closure!*

The warm, soft, Simulator body can now be slipped over and molded to form around the user's arm. Tighten the BOA closure to a firm fit and let the system cool until the body is formed more rigidly. Reinstall the terminal device of choice and harness. (PHOTO A1 & A2)

Please note that the terminal devices screw into the wrist on the end of the Simulator. A small "Allen" style, fitting screw in the wrist, allows the terminal device to be friction-locked in position. This screw is adjusted using the small, removable, Allen wrench "magnetically" attached to the Simulator's medial side for your convenience. (PHOTO B1 & B2). Position of the terminal devices is variable but they are typically used in the positions indicated in PHOTO B3.

ALWAYS! Loosen this screw when installing or removing a terminal device,

then tighten the Allen screw to the tension desired AFTER the terminal device is installed.

Adjusting the Harness

The Figure #9 Harness is fully adjustable. First adjust the Axilla Loop around the user's contra-lateral shoulder so that it completely and comfortably encompasses the shoulder and the harness ring sits on or slightly off the vertebra towards the contra-lateral side (PHOTO C). Attach the cable terminal fitting into the terminal device (Refer to other instructions and Photos F & G.). Now tighten (Shorten) the control strap attached to the hanger fitting and cable so that when the prosthesis is relaxed hanging alongside the body there is tension in the system…. ie. the cable is not slack and ANY shoulder or arm movement will begin to operate the terminal device.

Specifically Adjusting V/C: Tension the strap so that the voluntary closing prehensor is pulled about 1/3 closed, while the arms/prosthesis is relaxed by the side. When the forearm and prosthesis are flexed to 90 degrees the V/C Prehesor should be pulled closed. (PHOTO D) *The GRIP 3 has only one resistance spring that keeps the thumb open. It is not adjustable. Prehension is directly proportional and created and controlled entirely by the user.*

Specifically Adjusting V/O: Tension the strap so that the hook remains closed, while alongside the body, but begins to open with any shoulder or arm movement. Flexing the forearm and prosthesis to 90 degrees should pull the hook open. (PHOTO E) *The 5XA Hook is supplied with 2 elastic bands installed (Factory equivalent). Decreasing or increasing the number of bands will alter the amount of energy that is required to operate the hook and impact its maximum prehension. Prehension is inversely proportional to the force created by the user but directly proportional to the magnitude of closing force created by the elastic bands.*

Note researchers may want to develop a more precise adjustment protocol for the harness, cable tension and excursion with subjects to ensure that terminal device operation is optimized and comparisons during testing are reliable and valid.

Note if more direct control over the terminal device is required then shorten or tighten this control strap.

Also note that the harness may need to be removed off the shoulder to slacken the cable tension to more easily facilitate the changing of terminal devices and/or the attachment of the cable fitting to the terminal device.

The Split Hook TD may need to be HELD FULLY OPEN to more easily hook-up the cable! (PHOTO F)

The GRIP TD may need to be HELD FULLY CLOSED to more easily hook-up the cable! (PHOTO G)

Prosthetic Control Motions

These are the basic motions used to control a terminal device with a body powered prosthesis.

Gleno-humeral Flexion (reaching forward-arm extension) creates excursion and increases cable tension.

Uni-lateral or bi-lateral scapular abduction (shoulder rounding) creates excursion and increases cable tension.

Elbow flexion (Flexion of the forearm-prosthesis) creates excursion and increases cable tension.

Humeral Abduction (Raising arms laterally with elbows flexed) creates excursion and increases cable tension.

Bi-lateral Shoulder Elevation (Shoulder shrugging) reverses excursion and decreases cable tension.

Scapular Retraction (Squaring shoulders) reverses excursion and decreases cable tension.

Sure-Lok Cable Locking and Control Technology Function and Operation

Sure-Lok technology is installed on the prosthesis to increase the versatility and function of both the V/O and V/C terminal devices. Experiment with the Sure-Lok using both systems to completely understand and appreciate this cable locking and control technology. The Sure-Lok mechanism engages the "bare" cable inside the mechanism preventing it from moving "distally". The cable can still be pulled in proximally when the mechanism is engaged.

The Sure-Lok is used only for longer term holding or carrying tasks and holding delicate objects, when continuous cable tension is not convenient. It is not used for regular grasping and temporary holding use and will interrupt the valuable sensory feedback produced in a body-powered prosthetic system.

V/C Systems Operation

TO GRASP: Engage the Sure-Lok mechanism by pushing the actuation "yoke" forward-distally (PHOTO H) to engage the mechanism, while the thumb of the Prehensor is completely OPEN.

Reach forward and grasp an object… you can "size down on and grasp the object" and then relax cable tension. The object will remain in the terminal device. Continuing to apply cable tension will increase pressure on the object and potentially crush it. OR grasp the object first then engage the Sure-Lok by pushing the "yoke" distally-forward.

TO RELEASE: Apply slight tension to the cable as you pull the "yoke" back, proximally to release the mechanism.

V/O System Operation

TO GRASP: Open the hook TD and allow it to "size down" on the object to be grasped. Once engaged with the proper tension actuate the Sure-Lok mechanism by pushing the "yoke" forward-distally to lock the fingers in place. Adding tension at this point will allow the hook to open further and the object will be released and dropped.

TO RELEASE: Apply slight tension to the cable as you pull the "yoke" back proximally to release the mechanism.

Training with the Simulator

These are ideas to help teachers, students and test-evaluators learn how to operate the Simulator and may apply slightly differently for V/O and V/C prosthetic devices and systems.

First it's useful to just grasp a finger or fingers of your other hand… to experience the pressure that can be created by the terminal device… V/O or V/C. This task will help you learn to control prehension and "feel" using the proprioception (harness pressures) being generated.

Next, while standing, grasp onto a small solid, rigid object like a pencil or pen. While maintaining-monitoring cable control move the object in a horizontal circle in front of your body, as if you were stirring a large caldron… reverse the stirring direction without dropping the object.

Repeat the above, while seated. Notice changes in the harness tension and arm movements required to maintain control over the object.

Raise the solid object over your head, then hold it down laterally along the side of your leg…. while maintaining control.

Experiment holding the solid object in a variety of other body zones like reaching and crossing over body midline, etc.

Now repeat all of the above with a small, cocktail style, plastic cup that will crush or crack when cable control is lost or compromised.

This fragile object will make you realize the amount of concentration and cable control required to handle these more delicate objects.

Now repeat the activities cited above with the fragile object but utilize the function of the Sure-Lok mechanism and system. *Using the Sure-Lok eliminates much of the concentration required to maintain "safe" cable tension on the object.*

Rapid reaching and grasping can be valuable as well. A small bean bag or soft "Koosh" ball makes an easy to grasp object. Try quickly picking up and putting down the object OR picking up the object and placing it in a container then retrieving it.

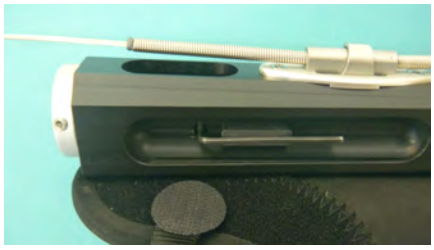
Advance to tossing and catching. A skilled prosthetic user can toss and catch these objects and that can be an ultimate goal of training with the prosthesis.

Experiment with other tasks.

A1

A2

B1



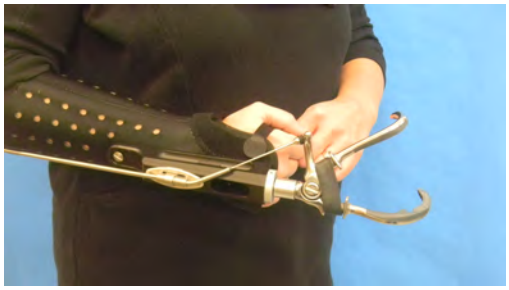
B2

B3

C

D

E



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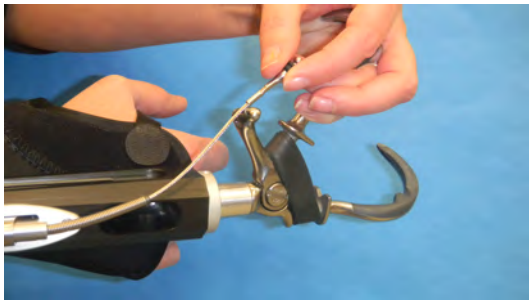

G

H