TOWARDS MORE VERSATILE GRASP: A NEW BODY-POWERED VO/VC TERMINAL DEVICE

Bradley Veatch

ToughWare Prosthetics

ABSTRACT

Terminal devices (TDs) for body-powered (BP) upper-limb prostheses typically operate using either voluntary opening (VO) or voluntary closing (VC) grasping modes. Individuals familiar with TD design recognize that under certain conditions one mode performs better than the other, and that ideally, users would be free to select—with minimal thought and disruption—the one they felt most appropriate for a given task. ToughWare Prosthetics' patented new VO/VC TD gives users this choice; the core grasping technology is purposefully robust and mechanically simple, comprising an elastic bungee-type cord, spatial lever, and contoured grasping elements. With the lever in one position, the elastic cord doubles on itself, producing a strong (additive) force used to achieve VO grasp. A second lever position causes the band to operate differentially, providing a reduced force for biasing the unit open during VC grasp. The mechanism exploits geometric symmetry between these two lever positions and the forearm cable attachment point to ensure the user's harness and cable remain correctly adjusted for optimal operation between VO and VC. Switching is accomplished by moving the spatial lever between positions; cable excursion is identical for both modes at 2-1/4 inches. Early field testing revealed that grasping contours optimized for VO operation were comparatively poor for VC, and vice-versa. In response, new contours were developed maximizing hook utility and grasping zone visual acuity for VO, and implementing a novel tilted-axis concept that optimizes grasp stability under high loads for VC that simultaneously minimizes hook interference. Replaceable compliant friction pads located on the hook faces and medial palm further enhance overall grasp quality. Designed for manufacturability, the new TD embraces state-of-the-art additive manufacturing processes in both plastic and metal to reduce cost and weight (9 ounces) while achieving an elegant, aesthetically pleasing design that is just 4-5/8 inches long. This versatile grasping technology is part of an ongoing pilot program exploring how new amputees equipped with on-demand VO and VC grasp capability employ those modes to become proficient in their use with the objective of deriving maximum benefit and enjoyment of their BP prosthetic appliances.