INTRODUCTION
There are two general types of body-powered prehensors, voluntary-opening (VO) and voluntary-closing (VC). VO devices are naturally closed by a spring, which makes them easy to use but limited by the weak grip force that is predetermined by the springs. VC prehensors require the user to pull on the cable to close the device, enabling the user to apply a large pinch force, but are more difficult to use because they require the user to constantly maintain the pinch force unless a bulky cam-lock is used.

A single prehensor that can readily switch between VO and VC modes would provide added functionality. Although many researchers have developed prototypes (Procter & LeBlanc 1991; Kuniholm 2008; Sensinger 2010; Veatch 2004; Sullivan & Siong Teh 2011), their implementations have been too heavy, bulky, or uncosmetic for clinical acceptance.

METHOD
Using a basic linkage and ball detent switch we have developed a simple, innovative switching system that allows the user to easily alternate between VO and VC modes (Figure 1 top). This device combines the most useful features of the VO and VC devices into a single VO/VC device.

The VO/VC prehensor is comparable in size to the Sierra 2-Load VO Hook (Figure 1 bottom) and uses commercially available, interchangeable tongs. A neutral thumb position is maintained for both modes which prevents the need for cable re-calibration when switching between VO and VC.

Using the Southampton Hand Assessment Procedure (SHAP) (Light, Chappell & Kyberd 2002), the performance of the VO/VC prehensor was compared against using either the VO mode or the VC mode in five able-bodied subjects wearing a transradial bypass prosthesis.

RESULTS
After practice, all five subjects chose to switch between VO and VC mode depending on the task. 4 out of 5 subjects obtained better SHAP scores when they were able to switch between VO and VC modes than when they used all VO or all VC mode.

DISCUSSION
A one-month field-trial will begin in October 2013.

CONCLUSION
If designed properly, VO/VC terminal devices improve performance in activities of daily living.

CLINICAL APPLICATIONS
This device could be used clinically in the near future after further refinement. The VO/VC device is particularly well suited for use in pediatrics as well as in developing countries.

REFERENCES