INTRODUCTION
Traditionally, myoelectric control of a prosthesis uses two antagonistic muscles. Users must learn to use their muscles independent of each other, often to produce motions that are not normally associated with that muscle contraction. As electrically powered prostheses become more complex, a more intuitive and reliable method of prosthesis control is required.

Pattern recognition could eliminate the need for complicated programming and adjustments. It may even allow individuals with poor myoelectric signal separation to use a myoelectric prosthesis since finding isolated myoelectric control sites is not necessary. With pattern recognition, multiple electrodes are placed on the skin to detect coordinated muscle activity. Successful pattern recognition allows the user to make natural intuitive movements to control corresponding prosthesis movements. Reported is the first independent, clinical case series implementing pattern recognition. It was conducted across multiple centers to a diverse patient population. This case series study provides initial evidence that pattern recognition can be implemented in standard prosthetic practices and is equal to or superior to conventional myoelectric control.

METHOD
This is an observational, interview study of prosthetists’ and patients’ experience in fitting, implementation, and use of pattern recognition systems. Experience from 10 prosthetists and 14 patients in Hanger’s Upper Extremity Prosthetics Program are reported. CoAPT Complete Control Systems (CoAPT LLC, Chicago, IL) systems were implemented. Subjects included male and female amputees. Amputation levels fitted include: shoulder disarticulation, trans-humeral, trans-radial, and wrist disarticulation. Two subjects had congenital limb deficiency. Five subjects had targeted muscle re-innervation (TMR) procedures.

RESULTS
In all cases, pattern recognition was found to have advantages over 2 site conventional control. User comments included: Faster response time, better proportional control, shorter learning curve, and no need for co-contraction.

DISCUSSION
The consistency in our results was surprising given that despite a diverse patient population and multiple clinicians, pattern recognition was found to have advantages over 2 site conventional control in all cases. We would have thought that there would be some cases that there would not be any advantages.

Prosthesis use training seemed easier using pattern recognition compared with conventional dual site control. This was especially true for the patients who had received TMR surgery and for the congenitally limb deficient.

Prosthesis fabrication was only slightly more complicated as a result of the increased number of electrode inputs and the need to find space for the added electronics. It may be beneficial to incorporate the pattern recognition electronics into the native component control modules of elbows and hands in the future.

CONCLUSION
Pattern recognition can be implemented in standard prosthetic practices and is equal to or superior to conventional myoelectric control, offering an attractive advance in upper extremity prosthetics. Generally pattern recognition makes prosthesis control more intuitive.

CLINICAL APPLICATIONS
This review of our first pattern recognition control patients supports the hypothesis that pattern recognition control is easier to learn and more intuitive than conventional control methods. Pattern recognition makes prosthesis use more spontaneous, especially when combined with TMR surgery and for congenitally limb deficient individuals.

REFERENCES