



## Preliminary Outcomes Comparing Function of Electric Multi-Articulating Hands and Digits, Toe-to-Hand Transfers and Hand Transplantations

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### INTRODUCTION

To date there has never been a national or international effort designed to compare the dexterous abilities, functional outcomes and “disability experience” of individuals who have been fit with advanced electric multi-articulating hands and digits, toe-to-hand transfers and hand transplantations. In order to begin adequately measuring these outcomes, a Functional Baseline Index score will be created that is defined by four validated and standardized hand dexterity tests. The purpose of this study is to present preliminary results that compare outcomes that have occurred following the dramatic advances in hand transplantation surgery and the emerging technological advances in electric prosthetic hands.

### METHOD

The subject population included 3 study groups; 14 prosthetic users of electric multi-articulating hands and digits, 2 individuals with toe-to-hand transfers and 4 with hand transplants. Each subject in the study was evaluated with the following validated and standardized tests; Box and Blocks Test (BBT), Nine Hole Peg (NHP), Disabilities of the Arm, Shoulder and Hand (DASH), and the Southampton Hand Assessment Procedure (SHAP). The Semmes-Weinstein monofilament test was included in the toe-to hand transfer as well as the hand transplantation subjects. Additionally a “Sensation versus Function” subjective questionnaire was designed in order to determine the perceived importance of sensation related to function.

### RESULTS

Due to the differences in subject group size and overall sample size, the data was calculated by *Cohen's d*- the *effect size*, to represent group differences. Subjects who utilize electric multi-articulating hands and digits perceived themselves as “less disabled” when compared to hand transplant subjects. ( $d=.96$ ). This was calculated by the DASH questionnaire. Subjects who utilize electric multi-articulating hands and digits scored slightly higher ( $d=.12$ ) in their overall “index of function” recorded by the Southampton Hand Assessment Procedure (SHAP). Toe-to-hand transfer subjects scored consistently better in the DASH and SHAP scores when compared to users of prostheses and hand transplant patients. Bilateral hand transplant subjects scored slightly better in manual dexterity, based upon their Box and Blocks Test score, and bilateral prosthetic users scored better in fine motor dexterity based upon the Nine Hole Peg scores. There were similar scores in function and “perception of disability”

in the unilateral transradial prosthetic users when compared to a unilateral hand transplant subject at the same level.

### DISCUSSION

This study presents preliminary results of the functional outcomes in a “compare and contrast” research design of 3 distinctly different study groups; prosthetic users of state-of-the-art electric hand and digit technology, toe-to-hand transfers subjects, and those who have undergone hand transplantations. Preliminary findings reveal dramatic advances in the functional abilities of these individuals as a result of prosthetic technology and advanced reconstructive microsurgical techniques. The stage is now set for continued study of these 3 subject groups in not only their functional outcomes, but also a comprehensive comparative overview of the important aspects of time (from procedure to “function”), costs, amount of therapy required, medications, potential complications, sensation, pinch and grasp force, as well as overall appearance.

### CONCLUSION

As dramatic advances are being made in the field of electric multi-articulating hand and digit technology, the field of reconstructive microsurgery and hand transplantation has experienced significant success as well. Defining this “success,” as it relates to functional outcomes for upper limb patients, is a primary objective for all of us to address. This study is a “First” in approaching this unique and challenging topic. Early results reveal that the outcomes of hand transplants, 2 years or more post-procedure, demonstrate similar outcomes of prosthetic users of advanced hand technology, as it relates to activities of daily living, fine motor and manual dexterity. What is interesting however, and requires further investigation, is that subjects who utilize electric multi-articulating hand and digits perceived themselves as “less disabled” when compared to hand transplant subjects.

### CLINICAL APPLICATIONS

Increasing interest in and exposure to unilateral and bilateral hand transplantation makes it incumbent upon prosthetists, therapists and physicians to become more aware of these surgical advances and the implications involved when patients ask for better understandings of what is best for them and how “the experience” and overall function of a hand transplant compares to “the experience” and overall function of advanced prosthetic hand technology.

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