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SPECIAL COMMUNICATION

Measurement of Outcomes of Upper Limb Reconstructive Surgery for Tetraplegia

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Abstract

Reconstructive arm/hand surgery for tetraplegia is performed to improve arm/hand function and therefore personal well-being for individuals who accept such elective surgeries. However, changes at an impairment level do not always translate into functional or quality of life changes. Therefore, multiple outcome tools should be used that incorporate sufficient responsiveness to detect changes in arm/hand function, activity and participation, and quality of life of the individuals involved. This narrative review aims to assist clinicians to choose the most appropriate tools to assess the need for reconstructive surgery and to evaluate its outcomes. Our specific objectives are (1) to describe aspects to consider when choosing a measure and (2) to describe the measures advised by an international therapist consensus group established in 2007. All advised measures are appraised in terms of the underlying construct, administration, and clinical relevance to arm/hand reconstructions. Essentially there are currently no criterion standard measures to evaluate the consequences of reconstructive arm/hand surgery. However, with judicious use of available measures it is possible to ensure the questions asked or tasks completed are relevant to the surgical reconstruction(s) undertaken. Further work in this field is required. This would be best met by immediate collaboration between 2 outcome's tool developers and by analysis of pre- and postoperative data already held in various international sites, which would allow further evaluation of the measures already in use, or components thereof.

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Measurement is carried out for a number of reasons: (1) diagnostic: to measure severity or extent of a feature present in an individual; (2) predictive: to make a prognosis; and (3) evaluative: to evaluate change over time and to measure outcome or results of treatment.[1,2] In the field of arm/hand surgery for tetraplegia, pre and postoperative measurement is used to assist with clinical decision-making to determine the best surgical options and evaluate surgical and postoperative rehabilitation outcomes by tracking patients' change over time in a variety of domains. These include hand function, upper limb capacity, activities and participation, satisfaction, and quality of life.[3]

The efforts and challenges regarding measurement outcomes of arm/hand reconstructions are well reported.[4-11] Impairment and disability levels, and the heterogeneity of the tetraplegic population, affect what types of measurements are possible. The small and heterogeneous patient population makes it difficult to recruit sufficiently large numbers of patients for outcome studies. This is even more difficult if the outcome tools used are too variable. Another challenge is to find broad acceptance of both performance and capacity measures capable of detecting small changes in multiple domains. Theoretically, multicenter data sets can be compiled and used for the evaluation of a range of novel treatment approaches, including robotics and passive work stations,

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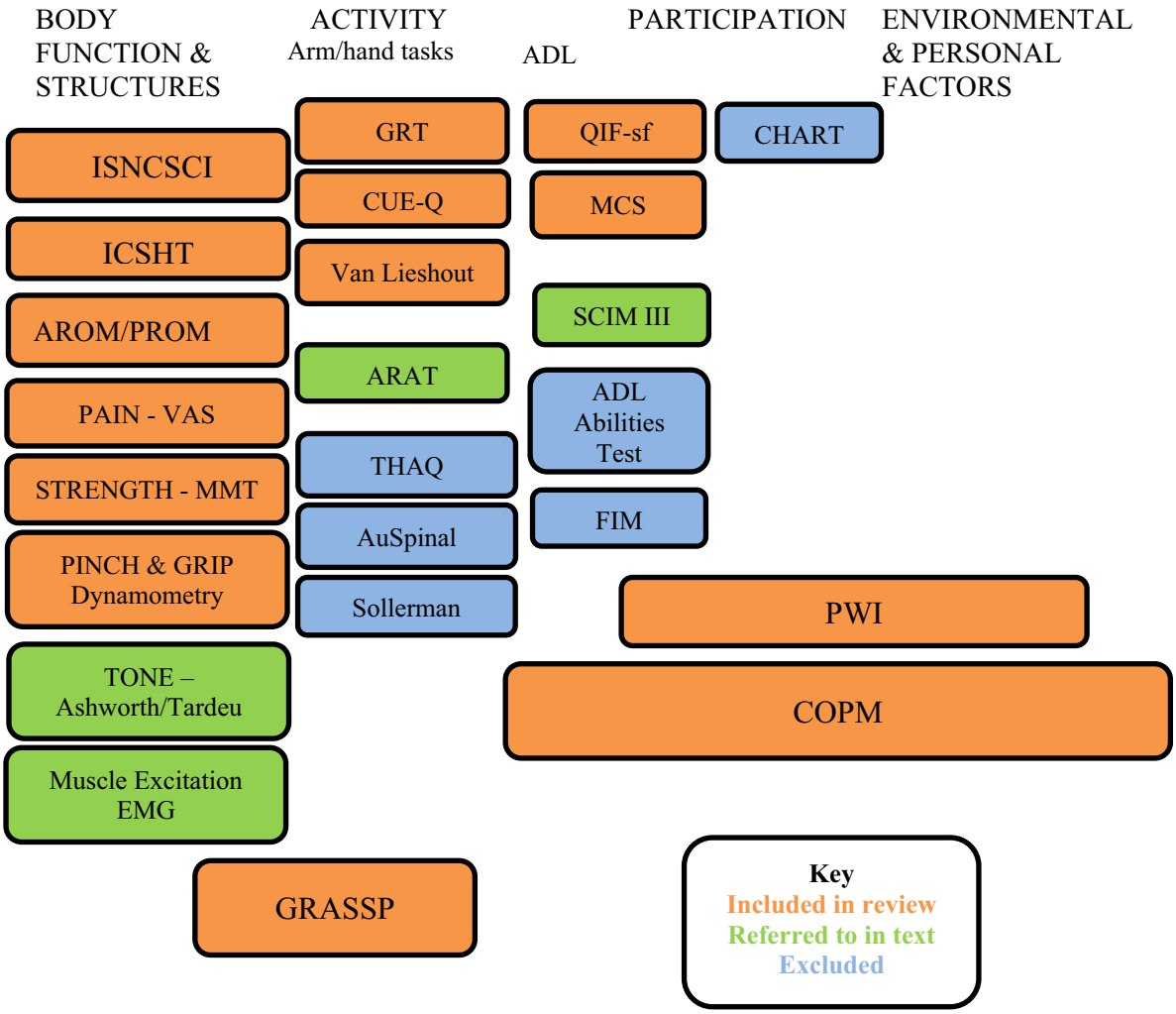

Fig 1 Variability of tools used by international centers in 2009 by ICF domain. Abbreviations: ADL, activities of daily living; ARAT, Action Research Arm Test; AROM, active range of motion; CHART, Craig Handicap Assessment and Reporting Technique; CUE-Q, Capabilities of Upper Extremity Questionnaire; EMG, electromyography; ICSHT, International Classification for Surgery of the Hand in Tetraplegia; ISNCSCI, International Standards for Neurological Classification of SCI; MCS, Motor Capabilities Scale; MMT, Manual Muscle Test; PROM, passive range of motion; QIF-SF, Quadriplegia Index of Function—short form; SCIM III, Spinal Cord Independence Measure III; THAQ, Tetraplegia Hand Activity Questionnaire; VAS, visual analog scale.

functional electrical stimulation, and nerve transfer procedures. However, in reality, collaboration among centers is complex not least because of the extensive measurement choices which limits uniformity. Within the field of spinal cord impairment research, there are a variety of organizations with comprehensive websites to better inform clinicians.[2] However, there are no specific recommendations for determining best practice in the measurement of the outcomes on arm/hand reconstructions.

List of abbreviations:

COPM	**Canadian Occupational Performance Measure**
GRASSP	**Graded Redefined Assessment of Strength, Sensibility and Prehension**
GRT	**Grasp and Release test**
ICF	***International Classification of Functioning, Disability and Health***
PWI	**Personal Wellbeing Index**
ROM	**range of motion**

An upper limb surgery therapist consensus group was initiated in 2007 at the International Meeting on Upper Limb in Tetraplegia in Philadelphia.[12,13] The primary aim of this effort was to create uniformity within the international hand surgery community. We worked to establish a consensus on a battery of measures from those in use at the time that would be most meaningful for this patient population and could be used to create an agreed system of measurement to be incorporated into the physical examination in clinical settings. A clinical registry was developed in New Zealand to complement this consensus.[12] The *International Classification of Functioning, Disability and Health* (ICF) was used to categorize measures at the levels of body function or structure, activities and participation, and the environment.[14] Figure 1 shows the full extent of measures used at the time by the represented centers, categorized according to the ICF. Not all available measures were considered by the consensus group as has previously been reported.[12] The tools were chosen on the basis of frequency of use in contributing centers, published psychometrics, and/or specific therapist research interests. Additionally, it was clear that full