

How to Measure Outcomes of Peripheral Nerve Surgery

Yirong Wang, MD^a, Malay Sunitha, MPH^b,
Kevin C. Chung, MD, MS^{c,*}

KEYWORDS

• Peripheral nerve • Hand surgery • Outcomes assessment

KEY POINTS

- Outcomes assessment tools and the current choices of measurements in outcomes research of peripheral nerve surgery.
- Several aspects relating to function, pain, and patient perception of outcomes are evaluated after peripheral nerve repair.
- Choice of specific measures depends on the researcher's interest and the disease or treatment under investigation.

The outcomes movement, initiated in 1988, was stimulated by the national emphasis on cost containment and efforts to limit geographic differences in the use of various medical procedures.¹⁻³ Goals of the outcomes movement included "increased understanding of the effectiveness of different interventions, the use of this information to make possible better decision making by physicians and patients, and the development of standards to guide physicians and aid third-party payers in optimizing the use of resources, by investigating and comparing patient experiences."^{1,4} Patient experiences can range from mortality, physiologic measures, reduction of symptoms, improvement in daily functioning, and clinical events to patient satisfaction.^{4,5} The outcomes chosen to evaluate care need to be carefully considered based on criteria that are most pertinent to the patient's need. Additionally vital are the criteria for selecting outcome measurement instruments, which comprise reliability, validity,

and responsiveness of measures, their clinical usefulness, and relationship to the care under investigation.⁵

Peripheral nerve injuries can be caused by trauma, accidental injuries during extensive surgery, nerve tumors, compressive disease, or congenital anomalies, with most (81%) located on an upper extremity.^{6,7} Among upper-limb or lower-limb trauma, incidence of nerve injuries is reported to be 1.64%, with crush injuries having the highest rate, at 1.9%.⁸ These injuries may lead to irreversible disabilities in patients, such as sensory loss, deficient motor function, pain problems in terms of cold intolerance and hyperesthesia, which impair hand function and affect quality of life at work and in society.⁷ Despite marked advances in neuroscience, peripheral nerve injuries continue to pose challenges for surgical reconstruction, because the clinical outcomes still seem unsatisfactory.^{6,7} Advances in this field require accurate measures of treatment

Supported in part by a Midcareer Investigator Award in Patient-Oriented Research (K24 AR053120) from the National Institute of Arthritis and Musculoskeletal and Skin Diseases (to Dr Kevin C. Chung).

^a 17th Department of Plastic Surgery, Plastic Surgery Hospital, Peking Union Medical College, Chinese Academy of Medical Science, 33 Ba-Da-Chu Road, Beijing 100144, China; ^b Section of Plastic Surgery, Department of Surgery, University of Michigan Health System, East Medical Center Drive, Ann Arbor, MI 48109, USA; ^c Section of Plastic Surgery, University of Michigan Medical School, University of Michigan Health System, 2130 Taubman Center, SPC 5340, 1500 East Medical Center Drive, Ann Arbor, MI 48109-5340, USA

* Corresponding author.

E-mail address: kecchung@umich.edu

Hand Clin 29 (2013) 349–361

<http://dx.doi.org/10.1016/j.hcl.2013.04.004>

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effectiveness to assess new treatments, which are forthcoming.

The assessment of recovery after peripheral nerve surgery remains a challenging process to therapists and surgeons. Numerous cellular and biochemical mechanisms that occur in peripheral and central nervous systems affect the outcomes and result in difficult evaluation of recovery.⁹ Measurement instruments for peripheral nerve surgery need to aid clinical diagnosis, assess and compare surgical repair techniques, track rehabilitation progress, provide feedback to both patient and therapist, as well as ascertain disability after injury.⁹ The list of objectives useful in evaluation of hand function after peripheral nerve repair is provided in **Table 1**. Outcomes research after nerve injury has recently had an emphasis more on functional results and patient-reported outcomes.^{10–13} This review focuses on the scope of outcomes assessment tools and the current choices of measurements in outcomes research of peripheral nerve surgery. **Table 2** details available methods for assessing patient outcomes after peripheral nerve surgeries.

OUTCOMES ASSESSMENT

Outcomes assessment in peripheral nerve injuries can be broadly categorized into tests of sensory function, motor function, pain and discomfort, and neurophysiologic and patient-reported outcomes.

Sensory Function

Sensory tests indicate the sensory acuity of the hand and how well the patient is able to use it.¹⁴ The Semmes-Weinstein monofilament test is used to assess perception of cutaneous pressure threshold, which reflects reinnervation of peripheral targets.¹⁵ Compared with using a common

tuning fork, the test provides quantitative data, which can be used to follow a patient serially during the course of nerve regeneration.¹⁶ Tactile gnosis is the capability of the hand to recognize the character of objects, such as shapes and textures, and is a prime marker of functional recovery.¹⁷ Two-point discrimination (2PD) is an established assessment tool for tactile gnosis.¹⁷ The static 2PD test (S2PD) measures the innervation density of the slowly adapting receptor (which fires continuously if pressure is applied) population.¹⁴ One study showed an age-related decline in the ability to discriminate 2 points, and there was no significant difference between men and women.¹⁸ The moving 2PD test (M2PD) relies on the quickly adapting receptor system (which fires at onset and offset of stimulation), which recovers sooner and in larger numbers.¹⁹ The threshold values are lower than those of the static test.²⁰ However, 2PD outcome in nerve repair studies is reported to be variable, because there is a lack of standardization of the technique and the test is probably performed in different ways by different investigators.²¹ It is a serious problem because the test is frequently used to compare different nerve repair techniques. Therefore, when 2PD results are reported in a study, a detailed and referenced description, especially the pressure applied and the testing protocol, should be mandatory.²¹ Dellon²² has introduced a pressure-specifying sensory device to provide a standardized pressure; however, it may be difficult to use this technique in routine clinical practice. The 2PD test is not recommended as the only instrument to monitor sensory function. Localization of touch and identification based on active touching are also recommended to be assessed for an overall evaluation of sensory function.²¹ Other functional sensory tests include shape, texture identification,^{23,24} vibration, and

Table 1
List of objectives to evaluate hand function after peripheral nerve repair

	Name of the Objective	Objective
1	Reinnervation	To demonstrate regeneration of the nerve and reinnervation of muscles and cutaneous receptors
2	Tactile gnosis	To determine the ability to interpret the new sensory input
3	Dexterity, grip strength, and activities of daily living capacity	To assess skills requiring integrated sensory and motor functions of the hand
4	Pain, discomfort	To quantify the degree of pain and discomfort in terms of hypersensitivity and cold intolerance

Data from Rosen B. Recovery of sensory and motor function after nerve repair. A rationale for evaluation. *J Hand Ther* 1996;9:315–27; with permission.

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