

ORIGINAL RESEARCH

Preliminary Psychometric Evaluation of the Brachial Assessment Tool Part 2: Construct Validity and Responsiveness



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Abstract

Objectives: To evaluate construct validity and responsiveness of the Brachial Assessment Tool (BrAT), a new patient-reported outcome measure for people with traumatic brachial plexus injury (BPI), and to compare it to the Disabilities of the Arm, Shoulder and Hand (DASH) and the Upper Extremity Functional Index (UEFI).

Design: Cross-sectional study.

Setting: Outpatient clinics.

Participants: Adults (N=29; age range, 20–69y) with confirmed traumatic BPI.

Interventions: Participants completed the BrAT 3 times over an 18-month period together with 16 DASH activity items and the UEFI. Evaluations were undertaken of construct validity, known-groups validity, 1-way repeated analysis of variance, and effect size.

Main Outcome Measures: BrAT, DASH, and UEFI.

Results: The BrAT demonstrated a moderate to low correlation with the DASH activity items (<0.7) and a large correlation with the UEFI (>0.7). According to known-groups validity, only the BrAT was able to discriminate between people who stated they could use their hand versus those who were unable to use their hand to perform activities. All measures indicated a significant effect for time with the exception of BrAT subscale 1. The effect size was highest for the BrAT but lower than expected (BrAT, .52–.40; DASH, .15; UEFI, .36).

Conclusions: These preliminary findings support the BrAT as a valid and responsive patient-reported outcome measure for adults with traumatic BPI. The BrAT activity items appear to be more targeted than the DASH or UEFI particularly for people with more severe BPI. The BrAT also appears to be measuring a different activity construct than the DASH and the UEFI. Further work is required to confirm these results with larger sample sizes.

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People with brachial plexus injuries (BPIs) demonstrate a wide spectrum of ability to use their arm to perform day-to-day activities. In recent years, microsurgical options have improved the outcome for people with this serious injury. For example, those with complete BPI should be able to stabilize or carry light objects with the affected arm, freeing the unaffected limb to perform more complex activities. Persons with a C5-6 injury may be expected to regain near-normal use of their affected limb.¹⁻³ However, the degree of heterogeneity seen in this population means that

assessment of outcome is complex. Outcome measures must contain a wide range of items that truly reflect the abilities of all adults with a BPI, including for those who may regain only a limited but important ability to use their arm.⁴

Patient-reported outcome measures are increasingly being recognized as pivotal to understanding the impact of an injury on the individual and are having a direct influence on the clinical decision-making process.^{5,6} While a few patient-reported outcome measures have been used to evaluate function after BPI, most do not contain items that assess the full range of ability of adults with a BPI.^{7,8} Further, none have been psychometrically evaluated for this population.^{7,9,10}

Disclosures: none.

The Brachial Assessment Tool (BrAT) is a new unidimensional, targeted, 31-item patient-reported outcome measure, with each item quantified on a 4-point scale. Experts, including people with BPI, generated items for inclusion in the BrAT based on the following *International Classification of Functioning, Disability and Health* (ICF) definition of activity: “execution of a task or action by an individual.”^{11(p.5)} The BrAT items are important to people with BPI, regularly performed and appear to represent the spectrum of ability of this population.^{8,12} The BrAT is composed of 3 subscales: (1) 8 “dressing and grooming” items, (2) 17 “whole arm and hand” items, and (3) 6 “no hand” items; or alternatively, all 31 items may be added to produce a summed score. Content validity and unidimensionality of the BrAT have been established using Rasch analysis.¹² Reliability has been evaluated and a minimal detectable change score calculated for each subscale and the summed score. Further evaluation of construct validity and responsiveness is required to complete the initial psychometric testing.

Construct validity is an ongoing iterative process that assesses how well a measure provides expected scores based on knowledge of the underlying construct.¹³ The underlying construct of a new outcome measure may be evaluated by comparing how closely items are related to existing measures that assess similar (convergent validity) or dissimilar (divergent validity) constructs. There is no known criterion standard to assess upper limb activity. The Upper Extremity Functional Index (UEFI) is a generic, 20-item patient-reported outcome measure designed to assess upper extremity function in people with musculoskeletal disorders. It is thus appropriate for use in conditions that involve the whole upper limb, and similar to the BrAT, assesses primarily activity of the upper limb.¹⁴ The Disabilities of the Arm, Shoulder and Hand (DASH)¹⁵ is the most frequently used patient-reported outcome measure after BPI. Comparison of the UEFI and the DASH to the BrAT is warranted.^{7,9,10}

In addition to ensuring an outcome measure is assessing what is intended (construct validity), outcome measures also need to be responsive^{13,16}—that is, able to detect change over time in the construct measured.¹⁷ Construct validity and responsiveness are related and considered by some to be the same measurement property.¹³ For this project, construct validity refers to the validity of a single score, and responsiveness refers to the validity of a change score.¹⁷ The purpose of this study was to investigate the preliminary construct validity and responsiveness of the BrAT.

Methods

This project used a multicenter, prospective repeated-measure design. Ethical approval was gained from 3 human research and ethics committees (Griffith University, Alfred Health, Melbourne Health), and all participants provided signed informed consent

List of abbreviations:

BPI	brachial plexus injury
BrAT	Brachial Assessment Tool
DASH	Disabilities of the Arm, Shoulder and Hand
GPUS	Global Perceived Use Scale
ICF	International Classification of Functioning, Disability and Health
UEFI	Upper Extremity Functional Index

before commencement of the project. The construct validity and responsiveness analyses were informed by the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) checklist recommendations.¹⁷

Participants

Participants comprised a convenience sample recruited from the 106 people with BPI who participated in the Rasch analysis arm of a previously reported project. Data were collected concurrently for the Rasch analysis, a reliability project, and this project.¹² The primary inclusion criteria for all 3 projects were (1) a diagnosis of traumatic BPI confirmed by magnetic resonance imaging, nerve conduction studies, clinical assessment, or intraoperative findings; and (2) age >18 years. In contrast to the reliability arm, participants were only recruited if they had undergone microsurgery to reanimate the upper limb within the previous 2 years. Thus, it was biologically plausible that their ability to use their arm could improve over the course of this project. Exclusion criteria for all 3 projects included (1) a diagnosis of brachial plexus birth injury; (2) pre-existing upper limb conditions; (3) an inability to provide informed consent; or (4) evidence of spinal cord injury confirmed by magnetic resonance imaging.¹²

Data collection

Once participants consented, they were mailed a copy of the BrAT together with the DASH¹⁵ and the UEFI¹⁴ at recruitment, and again at 9 and 18 months with a reply-paid envelope. A global perceived use scale (GPUS) was completed at 9 and 18 months. Outcome measures were reordered at each time point to decrease possible survey bias.¹⁸

Measures

Two outcome measures were compared with the BrAT. The DASH contains 30 items and is known to be multidimensional,^{19,20} with only 16 items specific to activity as defined by the ICF.^{7,8,21} These 16 items have been shown to contain 2 further dimensions, variously reported as “gross motor activities” and “fine motor activities”²⁰ or “shoulder range of motion” and “manual functioning.”¹⁹ Moreover, unlike the BrAT the DASH is not limb specific, with respondents able to answer irrespective of the strategy they use to complete the activities, including compensatory mechanisms or altering hand dominance.^{22,23} It is likely that the DASH may measure a different aspect of day-to-day arm use than the BrAT and demonstrate divergent validity. UEFI responses are attributed to the affected limb, and as with the BrAT, all but 2 of the 20 items (items 1 and 2) are specific to activity as defined by the ICF. The UEFI may assess a similar construct to the BrAT, demonstrating convergent validity.^{14,24} A priori hypotheses were formulated based on the expected relationship between the measures (table 1).^{13,25}

The 5-point GPUS was used as a reference criterion to anchor arm use as perceived by people with BPI during the evaluation period.^{25,26} Responses were attributed specifically to use of the affected limb. Options were as follows: 1, “much less than last time”; 2, “a little less than last time”; 3, “no change to last time”; 4, “a little better than last time”; and 5, “much better than last time.” Table 2 outlines the key measurement properties of the 4 measures.

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