EDITOR'S CHOICE

# Measurement Properties of the Brief Michigan Hand Outcomes Questionnaire in Patients With Dupuytren Contracture

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**Purpose** The brief Michigan Hand Outcomes Questionnaire (briefMHQ) was developed as a shorter version of the Michigan Hand Outcomes Questionnaire (MHQ), but its measurement properties have not been investigated in patients with Dupuytren contracture. The objective of the study was to investigate the reliability, validity, responsiveness, and interpretability of the briefMHQ.

**Methods** Fifty-seven patients diagnosed with Dupuytren contracture completed the briefMHQ as well as the full-length MHQ and Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH) questionnaire at baseline. Two to 14 days after baseline and 1 year after collagenase injection or surgery, patients again filled out the briefMHQ. Reliability was determined using the intraclass correlation coefficient and by calculating internal consistency (Cronbach alpha). Validity was tested by quantifying correlations with the full-length MHQ and QuickDASH. Responsiveness, based on the standardized response mean and the minimally clinically important change, was also determined.

**Results** The briefMHQ had an intraclass correlation coefficient of 0.87, Cronbach alpha of 0.88, and correlations of $r = 0.88$ and $-0.82$ with the original MHQ and QuickDASH, respectively. The standardized response mean was 0.9 and the minimally clinically important change was 7 points.

**Conclusions** Overall, the briefMHQ demonstrates excellent reliability, good validity, and high responsiveness in patients with Dupuytren contracture.

**Clinical relevance** The briefMHQ is an accurate and time-saving tool to evaluate patients with Dupuytren contracture and the effect of a corresponding treatment. *(J Hand Surg Am. 2016;41(9):896–902.* 

**Key words** Brief Michigan Hand Outcomes Questionnaire, Dupuytren contracture, reliability, responsiveness, validity.

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DUPUYTREN CONTRACTURE IS A prevalent hand disorder leading to considerable restrictions in daily life.[1,2] Therefore, measures of a patient's subjective function and their abilities in daily life are essential indicators for the evaluation of disease progression and the effect of an intervention.[3]

Various patient-reported outcome measures are available for evaluating function and quality of life in patients with hand disorders.[3–7] Of these, the Michigan Hand Outcomes Questionnaire (MHQ) shows good measurement properties for a variety of

 

hand disorders,[8] including patients with finger contractures.[9] With 37 items to be answered for both hands, completion time is about 15 minutes,[10] but some item redundancy exists.[11–14]

In order to reduce responder burden, the brief Michigan Hand Outcomes Questionnaire (briefMHQ), with only 12 items, was developed as a shorter version of the original tool.[15] Like the original MHQ, the brief version has excellent reliability and validity for a variety of acute and chronic hand disorders.[15] However, the measurement properties of the briefMHQ have not been specifically evaluated for patients with Dupuytren contracture.

Therefore, the aim of this study was to investigate the reliability, validity, responsiveness, and interpretability of the briefMHQ in patients with Dupuytren contracture.

## MATERIALS AND METHODS

### Patients and intervention

Patients diagnosed with Dupuytren contracture by an experienced hand surgeon (D.B.H. and S.S.) at our clinic and indicated to receive either a collagenase injection or surgical treatment, were asked to participate in this prospective cohort study. All eligible patients who provided their written informed consent were consecutively enrolled between August 2013 and July 2014. Exclusion criteria included patients younger than 18 years as well as those who were legally incompetent or with a lack of proficiency in the German language. Pregnant or breast-feeding patients were also excluded. Local ethical approval was obtained to conduct this study. According to Terwee et al's recommendations,[16] a sample size of at least 50 patients is adequate for the assessment of measurement properties. Allowing for a drop-out from the study, we aimed to include 60 patients.

Based on the attending surgeon's treatment recommendation, patients received either a collagenase injection or surgical treatment, comprising partial fasciectomy, and at least 1 session in the hand therapy department for construction of a custom orthosis.

### Assessments

The patients were assessed 3 times. Upon enrollment, a baseline examination was undertaken to collect sociodemographic and disease-related data. Patients were also assessed clinically and asked to complete a self-rating questionnaire set consisting of the briefMHQ, full-length MHQ, and Quick Disabilities of the Arm, Shoulder, and Hand questionnaire (QuickDASH). For reliability testing, patients completed the briefMHQ again within 2 to 14 days after the baseline examination and before their treatment intervention. For quality of life measures, it has been shown that there is no difference in test-retest reliability, if patients completed the questionnaire within 2 days or 2 weeks.[17] One year after the intervention, patients were again clinically evaluated and asked to complete the briefMHQ.

The briefMHQ contains 12 items that address patient-perceived hand function, activities of daily living, pain, work performance, patient satisfaction, and aesthetics based on a 5-point Likert scale.[15] After reverse-coding 8 questions and averaging, all items are totaled and then normalized to yield a summary score between 0 and 100. Higher scores indicate better overall functioning. In this study, we used the German version of the briefMHQ.[18]

The MHQ is a 37-item questionnaire, which is divided into the same distinct 6 subscales covered by the briefMHQ and yields results for each hand separately.[13] The MHQ total score is obtained by summing the scores for all 6 subscales (after reversing the pain scale) and then dividing the sum score by 6.[10] The total score ranges from 0 to 100 with a higher score indicating better hand performance. For the present analysis, we used the German version[19] and only the data of the affected hand.

The QuickDASH[20] is a shortened version of the Disabilities of the Arm, Shoulder, and Hand (DASH) tool[21] that comprises 11 items with sound measurement properties.[22–24] The QuickDASH assesses function of the whole upper extremity. Its score ranges from 0 to 100 with lower scores indicating better performance. Here, we also used the German version.[24]

Maximal hand grip strength was assessed using a Jamar dynamometer, and active extension deficit of the affected finger was measured with a standard 2-armed finger goniometer. We used the sum of the active extension deficit for all 3 finger joints. If more than 1 finger was affected, data from the finger with the most severe active extension deficit were reported.

At the 1-year follow-up, patients were asked about their perceived change regarding their finger condition: "In reference to your Dupuytren contracture on your finger joints, do feel *much better/slightly better/unchanged/slightly worse/worse* as before the injection/operation"? This 5-point Likert scale was transformed to a dichotomous scale with patients who had answered "much better" or "slightly better" being allocated to the improved group, and those with "unchanged," "slightly worse," or "worse" answers allocated to the comparison group of unimproved participants.

### Measurement properties of the briefMHQ and statistical analysis

The evaluation of measurement properties for the briefMHQ was based on definitions and recommendations of the COnsensus-based Standards for the selection of health status Measurement INstruments (COSMIN) group.[25–27] Reliability comprises the questionnaire's test-retest reliability, internal consistency, and measurement error. Test-retest reliability was estimated by calculating the intraclass correlation coefficient (ICC). The ICC ranges from 0.0 (no agreement) to 1.0 (perfect agreement) and describes how the same test results are obtained for repeated assessments when no real change is expected in hand condition within the assessment period. An ICC of 0.7 or greater is considered acceptable with values of 0.8 or higher considered optimal.[25] Using baseline data, we calculated Cronbach alpha to evaluate internal consistency. This estimation varies between 0.0 and 1.0, where values between 0.7 and 0.9 indicate good internal consistency; higher values may demonstrate redundancy of the questionnaire items.[25] The smallest detectable change (SDC), also known as minimal detectable change, represents the change beyond measurement error and any change smaller than the SDC can be regarded as the measurement error of the questionnaire.[25,28] The SDC was calculated using the formula:

$$1.96 \times \sqrt{2} \times \text{standard error of measurement}^{25}$$

The briefMHQ was compared with the known gold standard, the original-version MHQ, to assess criterion validity.[26] Correlations for validity were investigated with the 2-sided Spearman correlation coefficient (r). Values of less than 0.25 indicate a clinically irrelevant correlation, whereas values between and including 0.26 to 0.5, 0.51 to 0.75, and 0.76 or greater indicate mild, moderate, and good correlations, respectively.[29]

Construct validity measures the degree to which an instrument measures the construct(s) it is intended to measure. Convergent construct validity indicates that the instrument under investigation correlates highly with another instrument reflecting a similar construct.[25] For this purpose, the total QuickDASH score, grip strength of the affected hand, and active extension deficit were chosen as comparators. According to the COSMIN group recommendations,[25–27] predefined specific hypotheses were tested using baseline data: (1) there is a correlation between the briefMHQ and the QuickDASH with r of −0.7 or less; (2) there is a mild correlation between the briefMHQ and active extension deficit with r of 0.3 or greater; and (3) there is a mild or no correlation between the briefMHQ and grip strength with r of 0.3 or less. Furthermore, we calculated the correlation of the change score (baseline to 1 year) between the briefMHQ and the active extension deficit.

Responsiveness is defined as the ability of an instrument to detect change over time[26] and represented by effect sizes using Cohen d[30] and the standardized response mean (SRM). Values of 0.2 and 0.5 indicate a small and medium effect, respectively, whereas values of 0.8 or greater indicate a large effect.[30] Based on COSMIN group recommendations,[25–27] predefined hypotheses similar to the approach used for assessing validity were tested and included: (4) the SRM of the briefMHQ is 0.5 or greater; and (5) the SRM of the briefMHQ is higher than the SRM of grip strength.

The interpretability of the briefMHQ was defined as the degree to which qualitative meaning can be ascribed to its quantitative scores and is based on the calculation of MIC, also known as minimal clinically important difference.[28] The MIC is the smallest change patients consider important,[25] and was calculated using an anchor-based method and receiver operating characteristics curves. The question about perceived change in finger joint condition at the 1-year follow-up compared with baseline status was used as the dichotomous anchor. The optimal cutoff point, namely the point at which ([1-sensitivity] + [1-specificity]) is the smallest, reflects the MIC.[25] Furthermore, the area under the receiver operating characteristics curve (AUC) shows the ability of the briefMHQ to discriminate between improved and unimproved patients. A value of 0.5 indicates no discriminative ability, and an AUC of 0.75 or greater is regarded as appropriate.[31]

Floor and ceiling effects were calculated from the percentage of patients showing the lowest (0) or highest (100) value at baseline, respectively. Scores with floor or ceiling effects may not detect improvements or deteriorations in the patients because they are already at the lower or upper end of the scale. When more than 15% of the patients achieved the lowest or highest scores, an effect was noted.[16]

The 2-sided Wilcoxon signed-rank test was carried out for the briefMHQ, grip strength, and active extension deficit to observe any significant treatment effects between the baseline and the 1-year postintervention outcomes. This analysis was made for the entire group as well as stratified per intervention group.

## RESULTS

Of 60 patients enrolled in the study cohort, 3 withdrew their consent immediately after inclusion, which

**TABLE 1. Baseline Values and Outcomes at 1 Year for All Patients and Stratified by Intervention**

| | Baseline | | 1-Y Follow-Up | | |
|---|---|---|---|---|---|
| | N | Mean (SD) | N | Mean (SD) | *P* Value |
| BriefMHQ (all patients) | 57 | 71 (14) | 47 | 84 (17) | ≤ .001 |
| Injection* | 44 | 71 (15) | 38 | 84 (17) | ≤ .001 |
| Surgery* | 11 | 69 (12) | 9 | 82 (16) | .214 |
| Original MHQ total score (all patients) | 57 | 74 (16) | | | |
| Injection* | 44 | 74 (17) | | | |
| Surgery* | 11 | 71 (15) | | | |
| QuickDASH (all patients) | 57 | 17 (17) | | | |
| Injection* | 44 | 17 (18) | | | |
| Surgery* | 11 | 20 (15) | | | |
| Active extension deficit (°) (all patients) | 57 | 73 (32) | 29 | 29 (26) | ≤ .001 |
| Injection* | 44 | 75 (31) | 21 | 32 (28) | ≤ .001 |
| Surgery* | 11 | 65 (40) | 8 | 22 (19) | .03 |
| Grip strength (kg) (all patients) | 57 | 37 (13) | 27 | 37 (13) | .656 |
| Injection* | 44 | 37 (14) | 20 | 38 (14) | .679 |
| Surgery* | 11 | 36 (9) | 7 | 37 (13) | .397 |

*In each group, 1 patient cancelled the intervention.

resulted in complete baseline data for 57 patients. Two additional patients decided against undergoing their intervention but completed baseline and retest questionnaires. At 1 year, data for 47 patients were available. The average age of the study cohort at baseline was 65 years (SD, 8.9) and included 46 males (81%). Eleven patients underwent surgery, and 44 patients received a collagenase injection. The mean briefMHQ score for all patients increased from 71 (SD, 14) at baseline to 84 (SD, 17) at 1 year ($P < .05$; Table 1).

### Reliability

Test-retest reliability of the briefMHQ was high with an ICC of 0.87. Good internal consistency of this questionnaire was indicated by Cronbach alpha of 0.88. The SDC representing the measurement error was 16 points. For the QuickDASH, Cronbach alpha was 0.91.

### Validity

There was good correlation between the briefMHQ and its original long version as indicated by r = 0.88 (Table 2). As hypothesized, correlations of the briefMHQ with the QuickDASH (r = −0.82) and grip strength (r = 0.37) were within the estimated ranges. The correlation with the active extension deficit (r = −0.04) was lower than expected. However, the change score (baseline to 1 year) of the briefMHQ and the active extension deficit correlated mildly (r = − 0.36; Table 2).

### Responsiveness

Both hypotheses for responsiveness were confirmed because the SRM of the briefMHQ was 0.9 for all patients, which was higher than the SRM for grip strength (0.0; Table 3). The SRM of active extension deficit was −1.7.

### Interpretability

There were no floor or ceiling effects for the briefMHQ and the MIC is 7 points. The briefMHQ is able to distinguish between patients who improved (n = 40) and those who did not (n = 7), shown by an AUC of 0.93 (Fig. 1). Furthermore, 40 patients (85%) stated that they had at least a slight improvement, and the majority (n = 32; 68%) showed an improvement in the briefMHQ higher than the MIC.

## DISCUSSION

This study investigated the measurement properties of the briefMHQ, a short version of the original MHQ, in patients with Dupuytren contracture. The results provide evidence that the questionnaire demonstrates excellent reliability, good validity, and high responsiveness, which is similar to the measurement properties of the long version.

**TABLE 2. Criterion and Construct Validity of the BriefMHQ***

| | BriefMHQ | MHQ Total Score | QuickDASH | Active Extension Deficit (°) | Grip Strength (kg) | Change Score (Baseline − 1 y) BriefMHQ |
|---|---|---|---|---|---|---|
| BriefMHQ | 1.00 | | | | | |
| Original MHQ total score | **0.88**† | 1.00 | | | | |
| QuickDASH | **−0.82**† | −0.85† | 1.00 | | | |
| Active extension deficit (°) | **−0.04** | −0.09 | 0.02 | 1.00 | | |
| Grip strength (kg) | **0.37**‡ | 0.39‡ | −0.41‡ | −0.05 | 1.00 | |
| Change score (baseline − 1 y) active extension deficit | | | | | | −0.36 |

*Based on calculations using baseline data of the study cohort including 57 patients with Dupuytren contracture. All bold values indicate correlations relevant for hypothesis testing.
†$P \leq .001$.
‡$P \leq .01$.

**TABLE 3. Responsiveness of the BriefMHQ and Clinical Measures for All Patients and Stratified by Intervention**

| | n | SRM | ES |
|---|---|---|---|
| BriefMHQ (all patients) | 47 | 0.9 | 0.9 |
| Injection | 38 | 1.1 | 0.9 |
| Surgery | 9 | 0.5 | 0.8 |
| Active extension deficit (°) (all patients) | 29 | −1.7 | 1.6 |
| Injection | 21 | −2.3 | 1.7 |
| Surgery | 8 | −1.1 | 1.7 |
| Grip strength (kg) (all patients) | 27 | 0.0 | 0.0 |
| Injection | 20 | −0.1 | 0.0 |
| Surgery | 7 | 0.2 | 0.2 |

ES, effect size.

One reason for developing a shortened version of the original MHQ was the item redundancy demonstrated by Cronbach alpha values higher than 0.9 in several studies.[15] Our data confirm that this goal has been achieved. Furthermore, our data support the excellent test-retest reliability of the briefMHQ,[15] which is similar to the original MHQ.[8] The measurement error (SDC), however, was 16 points, which is quite high. Another study investigating the measurement properties of the original MHQ in patients with thumb osteoarthritis found a lower SDC of 11 points, probably due to a higher sample size.[32] Nevertheless, changes beyond the SDC found in our study might be due to a measurement error.

Our results show good criterion validity of the briefMHQ, which highly correlates with its original version. Regarding the questionnaire's construct validity, we were able to confirm 2o hypotheses. However, we could not show a correlation between the briefMHQ and the active extension deficit at baseline but a mild correlation of the change score. Nevertheless, these findings are in line with those of Budd et al,[33] who were also unable to show a correlation with the outcome of extension deficit and the QuickDASH score in patients with Dupuytren contracture. Other studies have also indicated that range of motion (ROM) of the hand is only slightly correlated with patient-reported outcomes.[34–36] Rodrigues et al[37] have stated that it may not be appropriate to measure only active extension deficit in Dupuytren contracture—hand function is much more complex and requires a more comprehensive evaluation. Therefore, we recommend the evaluation of both domains—ROM and function as measured by a questionnaire.

A large effect was found for the briefMHQ indicating high responsiveness. Our values were similar to those reported in the literature for the brief and the original MHQ.[36,38] Furthermore, other studies investigating patients with Dupuytren contracture show higher SRM and effect size values of those questionnaires compared with the QuickDASH, indicating better responsiveness of the MHQ instruments.[36,38] However, the SRM in our study was slightly lower than those of Waljee et al,[15] who found values between 0.9 and 1.3 for patients treated surgically for distal radius fractures, carpal tunnel syndrome, or rheumatoid arthritis. We hypothesize that the higher responsiveness in the latter study is due to the patients' condition. In patients suffering from these conditions, pain usually plays an important role, whereas the most important issue in patients

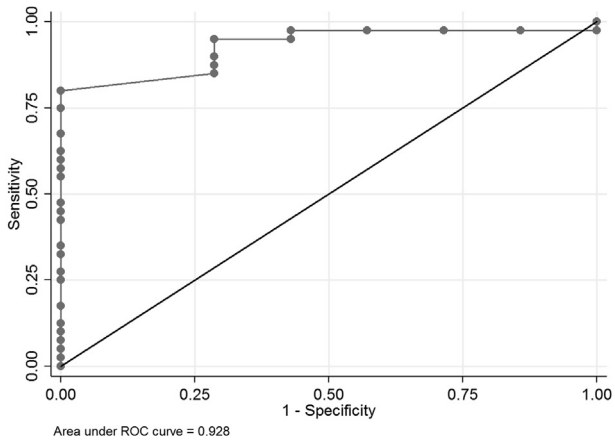


**FIGURE 1:** Receiver operating characteristics (ROC) curve for the briefMHQ total score of 47 patients with Dupuytren contracture who completed the 1-year follow-up assessment.

with Dupuytren contracture is the extension deficit.[1,39] Because 2 of the 12 briefMHQ questions concern pain, the change in the total score would be lower if patients experience no or only slight pain; this was apparent in our patient cohort. Although the briefMHQ is not as sensitive for detecting changes as ROM, we recommend its supplementary use, because it covers the additional domains of pain, function, and appearance.

The MIC was 7 points, indicating that an improvement by more than 7 points in the briefMHQ score after an intervention is clinically meaningful to an individual patient. However, our calculated MIC was smaller than the SDC, which weakens the importance of the MIC. Other studies investigating the MIC of the original MHQ and its subscales in patients with other hand disorders found values between 3 and 23 points,[8,32] most of them being higher than the MIC found in our study. Therefore, our MIC must be interpreted carefully. Furthermore, interpreting the MIC should also consider the individual patient's condition, because the MIC is influenced by the baseline score, which already was high in our cohort. Investigating the QuickDASH, it has been shown that better baseline function is associated with lower values for the minimal clinically important difference.[40]

The results of our study support those of Waljee et al[15] in that the briefMHQ shows similar measurement properties to the original version. The briefMHQ is highly recommended as a more efficient tool in large studies, as a cross-sectional screening tool, and for documenting the outcome in routine clinical practice, because it reduces responder burden and increases response rates.[15] However, the use of the original MHQ is still advocated for use in clinical research because it provides a more comprehensive analysis of the patient's condition.[15] In addition, the original MHQ can assess the 2 hands separately, so that stratification for hand dominance or affected hand is possible,[12] something which neither the briefMHQ nor the QuickDASH allows.

This study is limited by its small sample size of 57 patients, which may cause high SDs as well as a high SDC value, resulting in a less meaningful value of MIC. The calculation of the MIC included only 7 deteriorated patients, further limiting the validity of the MIC. In addition, further studies are required to compare the briefMHQ with other hand-specific patient-reported outcome measures, for example, the Unité Rhumatologique des Affections de la Main scale,[41] which has been developed specifically for patients with Dupuytren contracture.

Based on our results, we can conclude that the briefMHQ shows excellent reliability, good validity, and high responsiveness in patients with Dupuytren contracture. We recommend this questionnaire as an accurate and time-saving tool to evaluate patients with Dupuytren contracture and the effect of a corresponding treatment in daily practice and for registries. However, for specific research questions and a more comprehensive evaluation, the original MHQ is still favored.

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