



■ FOOT & ANKLE

The Manchester–Oxford Foot Questionnaire (MOXFQ)

DEVELOPMENT AND VALIDATION OF A SUMMARY INDEX SCORE

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Objectives

The Manchester–Oxford Foot Questionnaire (MOXFQ) is a validated 16-item, patient-reported outcome measure for evaluating outcomes of foot or ankle surgery. The original development of the instrument identified three domains. This present study examined whether the three domains could legitimately be summed to provide a single summary index score.

Methods

The MOXFQ and Short-Form (SF)-36 were administered to 671 patients before surgery of the foot or ankle. Data from the three domains of the MOXFQ (pain, walking/standing and social interaction) were subjected to higher order factor analysis. Reliability and validity of the summary index score was assessed.

Results

The mean age of the participants was 52.8 years (SD 15.68; 18 to 89). Higher order principle components factor analysis produced one factor, accounting for 74.7% of the variance. The newly derived single index score was found to be internally reliable ($\alpha = 0.93$) and valid, achieving at least moderate correlations ($r \geq 0.5$, $p < 0.001$) with related (pain/function) domains of the SF-36.

Conclusions

Analyses indicated that data from the MOXFQ can be presented in summary form. The MOXFQ summary index score (MOXFQ-Index) provides an overall indication of the outcomes of foot and ankle surgery. Furthermore, the single index reduces the number of statistical comparisons, and hence the role of chance, when exploring MOXFQ data.

Keywords: Patient-reported outcome measure, MOXFQ, Foot and ankle, Outcomes, Surgery, PROM

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Article focus

- An established validated patient-reported outcome measure for foot and ankle surgery: the Manchester–Oxford Foot Questionnaire (MOXFQ), comprises three subscales: pain, walking/standing and social interaction
- A statistical procedure is used to investigate whether these three subscales can be combined into a single summary index score that measures the overall impact of an intervention on foot or ankle related problems

Key messages

- The MOXFQ can be presented in summary form, as the MOXFQ-Index
- The index has a high level of internal consistency and forms constructive

relationships with related scales of the Short-Form (SF)-36

- The impact of foot and ankle problems on specific domains of quality of life can be evaluated with the subscales, while the overall impact is assessed using the MOXFQ-Index

Strengths and limitations

- Strengths: a single figure provides a summary of overall impact and, compared with when using a profile of scores, can reduce the number of statistical comparisons and consequently reduce the role of chance in testing hypotheses about health status and quality-of-life outcomes
- Limitation: the MOXFQ-Index offers marginally less detail than is achieved using the three subscales

Introduction

Appropriately designed condition-specific patient-reported outcome measures (PROMs) can provide reliable and valid measures of issues that are of most concern to patients, such as pain, function, mobility and health-related quality of life. This approach provides standardised data on patients' perceptions, generally in the form of a scale or score derived from a set of questions that together measure a particular construct (such as 'walking difficulty'). PROMs are increasingly being used in clinical trials¹ and to assess outcomes of health care.²

The Manchester–Oxford Foot Questionnaire (MOXFQ) (Isis Innovation Ltd, Oxford, United Kingdom)^{3,4} is a PROM for surgery of the foot and ankle, developed as an outcome measure for clinical trials of surgery and potentially for other interventions (including trials of drugs and orthotics) and contexts (such as audit and individual patient monitoring). With item content originally informed by interviews with appropriate patients and extensive validation conducted across a range of foot and ankle conditions in the surgical setting,³⁻⁶ the MOXFQ fully conforms to recent guidance from the United States Food & Drug Administration (FDA) for industry regarding the development and appropriate application of PROMs.⁷ These state that, in addition to involving patients in their development, PROMs need to be validated for the population and context in which they are to be used.

Several widely used PROMs now incorporate summary index scores as an additional means of reporting respondent data. Examples include the generic Short-Form (SF)-36,⁸ the disease-specific Parkinson's Disease Questionnaire (PDQ)-39⁹ and the Quality of Life Questionnaire for Neuromuscular Disease (INQoL).¹⁰ It has been suggested that the benefits of summary scores are twofold. First, a reduction in the number of domains on a measure reduces the number of statistical comparisons, and consequently decreases the role of chance in testing hypotheses relating to health outcomes.¹¹ Secondly, interpretation of data over a number of domains can be problematic if attempting to gain insight into the overall impact of a health condition.¹² Summary scores can therefore be useful in gaining insight into overall impact when assessed via measures that give a profile of scores.

The statistical procedure of higher order factor analysis has been described and employed to reduce the number of domains on instruments such as the SF-36^{11,12} and PDQ-39¹³ in order to create a summary score. The original development of the MOXFQ identified three domains, which are scored and used as separate scales. The aim of this study was to examine the possibility that the three MOXFQ domains could be amalgamated to provide a single summary index score.

Materials and Methods

NHS Research Ethics Committee approval (ref 08/H0604/68) was obtained as part of a wider study reported

elsewhere.⁵ Written informed consent was obtained from all participants.

Participants. Consecutive adult NHS patients booked for foot or ankle surgery within a 12-month period at a regional specialist hospital were sent a letter of invitation within three months before their operation. Of a total of 764 patients contacted, 671 patients consented to take part in the study and completed pre-operative assessments when they attended the hospital pre-admission clinic or on the day of surgery (response rate of 87.8%). Of the 671 patients, 68 (10.1%) were booked for bilateral foot/ankle surgery.

Measures. Participants completed two instruments: the MOXFQ^{3,4} and the SF-36.⁸ The MOXFQ is a 16-item instrument answered on a five-point Likert scale (each item is scored from 0 to 4, with 4 denoting 'most severe'). Scores for each item are summed to form three separate subscales representing underlying domains: walking/standing problems (seven items), foot pain (five items), and issues related to social interaction (four items). Raw scale scores are then each converted to a metric from 0 to 100, where 100 denotes the most severe. The three domain scales (walking/standing, pain, and social interaction) have been shown to have excellent psychometric properties in terms of reliability, validity and responsiveness.³⁻⁶

The SF-36 is a 36-item instrument comprising eight domains (physical functioning, role physical, role emotional, social functioning, mental health, energy/vitality, pain and general health perception) that has been extensively used and shown to have excellent psychometric properties.^{14,15} Raw scores for each domain are transformed to have a range from 0 to 100 with higher scores indicating superior health status (i.e. the opposite direction of the MOXFQ).

Statistical analysis. Health status data were checked for the presence of outliers and to check the normality of score distribution before statistical analysis. Raw scores from the three domains of the MOXFQ were subjected to higher order principal components analysis. Reliability of the summary index score was assessed using Cronbach's alpha,¹⁶ with minimum alpha values of 0.80 considered to indicate good consistency¹⁷ and validity by analysing Pearson correlation coefficients with the eight domains of the SF-36. It was hypothesised that, because the MOXFQ's conceptual framework particularly addresses pain and function in relation to foot/ankle problems, correlations would be large ($r \geq 0.5^{18}$) between the MOXFQ summary index score and domains on the SF-36 that related to pain and function (pain, physical function, role physical, energy/vitality, social functioning and physical health summary index), while correlations would be lower/moderate ($0.3 < r < 0.5^{18}$) in relation to SF-36 domains more concerned with mental health (role emotional, mental health, general health perception and mental health summary index). Data were analysed using SPSS v20 (IBM SPSS, Armonk, New York). A p-value < 0.05 was considered to indicate statistical significance.

Table I. Descriptive statistics for the domains and summary index of the pre-operative Manchester–Oxford Foot Questionnaire (MOXFQ)

MOXFQ domain	Mean score (SD)*
Walking/standing	59.20 (28.52)
Pain	57.10 (21.89)
Social interaction	47.34 (25.22)
MOXFQ-Index	55.32 (22.48)

* higher scores denote greater severity

Results

A total of 671 patients were included. There were 427 women and 244 men, with a mean age of 52.8 years (18 to 89). Descriptive statistics for the MOXFQ walking/standing, pain and social-interaction domains are reported in Table I.

The three domains of the MOXFQ were subsequently subjected to higher order factor analysis. One factor with an eigenvalue > 1 was identified, accounting for 74.7% of the variance (extraction method principal component analysis). Each domain of the MOXFQ loaded on this one factor, generating an eigenvalue of 2.24. Consequently, all three domains of the MOXFQ were summed and converted to a metric from 0 to 100 to create a summary index score (MOXFQ-Index). Cronbach's alpha was calculated as 0.93. The mean MOXFQ-Index was 55.32 (SD 22.48; 0.00 to 100). Correlations with the domains of the SF-36 are presented in Table II. All were highly statistically significant ($p < 0.001$), while correlations with SF-36 pain, physical function, role physical, social function and energy/vitality domains were all $r \geq 0.5$.

Discussion

Few outcome measures have been subjected to such rigorous testing of their measurement properties as the MOXFQ, which is increasingly being used by European specialists in foot surgery¹⁹⁻²¹ and is gradually being translated into other languages.

The impact of treatment on specific domains (walking/standing, pain, social interaction) of foot/ankle-related problems can be evaluated using the three MOXFQ subscales ('profile scores'), which offers a high level of precision. However, results reported here provide evidence for the creation of an additional summary index of patient health status that is based on the three domains of the MOXFQ with higher order factor analysis supporting the derivation of the MOXFQ summary Index score (MOXFQ-Index). Strong evidence was also presented demonstrating that foot and ankle problems have an overall effect on patient health status, especially in relation to aspects of pain and function (including social function/interaction) that are addressed by three domains of the MOXFQ. Reliability of the summary measure was assessed using Cronbach's alpha, which was found to be high, indicating that the index created by summing the three domains is

Table II. Pearson correlations between the Manchester–Oxford Foot Questionnaire (MOXFQ) summary index score and the domains of the Short-Form (SF)-36

SF-36 domain	R*	p-value
Physical functioning	-0.70	< 0.001
Role physical	-0.64	< 0.001
Role emotional	-0.49	< 0.001
Social functioning	-0.60	< 0.001
Mental health	-0.39	< 0.001
Energy/vitality	-0.52	< 0.001
Pain	-0.70	< 0.001
General health perception	-0.34	< 0.001
Physical health summary index	-0.70	< 0.001
Mental health summary index	-0.33	< 0.001

* correlations are negative because the MOXFQ and SF-36 domains are scored in opposite directions

internally consistent. Evidence for validity was supported by the attainment of at least moderate (and highly significant) correlations with hypothesised relevant domains of the SF-36. The MOXFQ-Index therefore suggests that the overall impact of foot and ankle problems affects many aspects of health status as measured by the eight domains of the SF-36.

In conclusion, the MOXFQ can be presented in profile form as well as summarised using the MOXFQ-Index. Thus, the impact of foot and ankle problems on specific domains of QoL can be evaluated with the profile scores, while the overall impact is assessed using the MOXFQ-Index. Such an index has the potential for use in the assessment of foot and ankle surgery (and potentially other interventions) over time, in clinical trials and other contexts, as interpretation of a single figure can often be less complex than that of a profile of scores. Furthermore, the adoption of a single index measure of outcome can reduce the number of statistical comparisons and consequently reduce the role of chance in testing hypotheses about health status and QoL outcomes.

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The MOXFQ questionnaire and permission to use the measure can be acquired from Isis Innovation Ltd, the technology transfer company of the University of Oxford via website: <http://www.isis-innovation.com/outcomes/index.html>

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Author contributions:

- D. Morley: Contributed important intellectual content. Data analysis. Wrote first draft. Edited the final draft
- C. Jenkinson: Provided psychometric expertise. Aided data interpretation. Edited final draft
- H. Doll: Provided statistical expertise. Assisted interpretation of the data. Some writing. Edited final draft
- G. Lavis: Data collection relating to clinical assessments. Contributed input leading to revisions to the manuscript. Edited the final draft
- R. Sharp: Data collection relating to clinical assessments. Input leading to revisions to the manuscript. Edited the final draft
- P. Cooke: Data collection relating to clinical assessments. Input leading to revisions to the manuscript. Edited the final draft
- J. Dawson: Data analysis. Wrote a proportion of the first draft. Edited the final draft. Study principal investigator

ICMJE Conflict of Interest:

- Jill Dawson occasionally provides consultancy work for Isis (Oxford, United Kingdom), the technology transfer company that owns the copyright of the MOXFQ. In all other respects all of the authors declare that they have no competing interest that could influence the content of this paper and its conclusions

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