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Selecting, assessing and interpreting measures of function for patients with severe hip pathology: the need for caution.

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Abstract

Introduction

It is not always possible to use a combination of patient-reported outcome measures (PROMs), performance tests and clinician-administrated measures to assess physical function prior to hip surgery. We hypothesised that there would be low correlations between these three types of measure and that they would be associated with different patient characteristics.

Materials and methods

We conducted a cross-sectional analysis of the pre-operative information of 125 participants listed for hip replacement. The WOMAC function subscale, Harris Hip Score (HHS) and walk-, step- and balance-tests were assessed by questionnaire or during a clinic visit. Participant socio-demographics and medical characteristics were also collected. Correlations between functional measures were investigated with correlation coefficients. Regression models were used to test the association between the patient's characteristics and each of the three types of functional measures.

Results

None of the correlations between the PROM, clinician-administrated measure and performance tests were very high (<0.90).

Associations between patient characteristics and functional scores varied by type of measure. Psychological status was associated with the PROM (p-value<0.0001) but not with the other measures. Age was associated with the performance test measures (p-value ranging from ≤0.01 to <0.0001) but not with the PROM. The clinician-administered measure was not associated with age or psychological status.

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Discussion

Substantial discrepancies exist when assessing hip function using a PROM, functional test or a clinician-administered test. Moreover, these assessment methods are influenced differently by patient characteristics. Clinicians should supplement their pre-surgery assessment of function with patient-reported measure to include the patient's perspective.

Level of evidence

III – observational cross-sectional study.

Keywords

Physical functioning, hip replacement, patient-reported outcome measure, performance test, clinician administrated measure.

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Introduction

Physical functioning in patients undergoing hip surgery is commonly assessed in three ways [1]: patient-reported outcome measure (PROM), performance test, or clinician-administered measure. It is recommended that several types of measures are used concurrently to capture an extended picture of function [2, 3] and ideally patient-reported symptoms and surgeon's assessment must fit together before deciding on operating. Patient fatigue and burden, time, resources and logistical constraints of clinic and research appointments mean that collecting multiple measures is seldom feasible, leading to focus on a limited number of measures, if not a single one.

The standardised nature of performance tests and clinician-administered measures confer some objectivity, but they are resource intensive and may not assess the functional limitations experienced during the activities of daily living of relevance to patients [4, 5]. PROMs are easier to use, put patient's perspectives at the centre of the assessment and can take into account environmental or behavioural adaptations, but are subjective [4].

Performance tests tend to only describe activity limitations, while PROMs and clinician-administered measures also focus on impairment [1, 6].

It is also unclear if these measures have similar relationships with the characteristics of patients. These characteristics can influence the actual level of functional ability and how function is perceived and reported [3, 7-10]: For example, obesity and bone structure can affect the accuracy of clinical measures [11], and age and vulnerability can influence communication with interviewers [12].

We hypothesised that functional limitations evaluated prior to hip surgery with only one outcome measure would provide a biased assessment of function. While there is evidence that performance-tests and PROMs do not fully correlate [13-16], correlations between PROMs, performance tests and clinician-administrated measures are yet to be evaluated. Furthermore, it is also not known if the associations between function and patient characteristics depend on how function is measured. .

The aim of our study was to use different measures to assess function in the same group of patients before their hip surgery to determine 1. how well PROMs, performance tests and clinician-administrated measures correlate with one another and 2. whether these measures are associated with the same patient characteristics.

Methods

The data are from a prospective single centre cohort study including patients undergoing hip replacement (primary or revision). Detailed information on study design, ethical approval, patient recruitment and consent, and assessment methods are in the study protocol [1]. (Participants listed for a knee replacement were not included in this analysis). Participants were sent a pre-operative questionnaire about their characteristics and functional limitation and were then invited to an appointment during which performance tests and clinician-administered measure were completed.

Functional measures

The clinician-administered functional test was the Harris Hip Score (HHS) [17]. The PROM was the function component of the WOMAC score [18]. The performance tests were a timed 20-metre walk (Meters/second), step (ability to climb a 30cm high block), and single stance balance (ability to stand balance for 15 seconds) tests.

Patient characteristics and pain

Participants provided data about their age, gender, living arrangements, level of education and working status. Comorbidities were collected with the Functional Co-morbidity Index (FCI) [19]. Psychological distress was assessed with the Hospital Anxiety and Depression Scale (distress defined as having a score >10 on either of the anxiety and depression subscales or a combined score of ≥15 with a score of at least eight on each of the two subscales) [20]. Arthritis severity was derived as a count of affected joints other than the joint listed for surgery. Information on body mass index and type of surgery were extracted from medical records. Pain was self-reported with the pain component of the WOMAC score [18].

Statistical analyses

The relationships between the different types of functional measure were assessed with Spearman Rank (for correlations between continuous variables) or point-biserial (for correlations between continuous and dichotomous variables) coefficients. The strength of correlation was considered high from |0.70| to |0.89| and very high from |0.90| to |1.00|. [21]. Associations between participants' pain or characteristics (independent factors) and each functional outcome (dependent factor) were first investigated with univariable regressions (unadjusted model). Characteristics with evidence of an association (p-value≤0.05) were then included in a multivariable model to identify those which remained independently associated with the functional outcome under investigation (adjusted model). Linear regressions were used to model continuous functional outcomes, i.e. HHS, WOMAC-function and walking speed test (transformed as 1/time). Step and balance tests were dichotomous outcomes and modelled with modified Poisson regressions with robust error variance. Although few participants had missing information, missing data were addressed using a multiple imputation by Chained Equations approach to produce ten imputation sets and estimates were combined using Rubin's rules. Statistical analyses were performed with Stata 13.

Results

Study population

Overall, 645 eligible patients listed for hip replacement were approached and 131 consented to take part (20.3%). There was no difference in the age, gender or type of planned surgery between participants and non-participants. A total of 125 participants listed for hip replacement had complete pre-operative data and were included in the analysis. Participant characteristics are displayed in table 1.

The functional measures were completed approximately two weeks before surgery (median: 15 days, IQR: 23 days) and are described in table 2.

Relationships between functional measures (table 3)

The HHS was highly and significantly correlated with WOMAC-function (correlation coefficient=0.71). Both HSS and WOMAC-function were moderately correlated with walk-time (respectively 0.67 and 0.56) but had low correlations with the other performance tests .

Associations between patient characteristic, pain and functional measures (Tables 4 and 5)

Age was independently associated with the performance tests but not WOMAC-function or HHS. Gender was related to most measures except HHS. After adjustment, psychological distress was related with WOMAC-function but no evidence of association was found with HHS or performance tests.

Pain was associated with all measures of function. No evidence of association was found between function and co-morbidities, BMI, severity of arthritis, living arrangement, education or working status.

Discussion

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The key findings from this study are that PROMs, performance tests and clinician-administered measures do not correlate very strongly (i.e. no correlations≥0.90), and that they are each associated with different patient characteristics. This confirms our hypothesis that in a situation where only one assessment of function can be performed, results are likely to be incompletely described and may not reflect patient's needs if they have not been obtained with a PROM.

Several assessments of different types are required to obtain a comprehensive and unbiased evaluation of function prior to hip replacement. This is not always possible when resources and time are sparse. When only one assessment can be performed, choosing only one tool from the WOMAC-function, HHS and walking-test measures will not reflect completely the degree of functional limitations. Patient's characteristics also need to be taken into account when assessing function. If WOMAC-function is used, findings are likely to be influenced by psychological status and gender but not age. On the contrary, the walking-test, like the other performance tests, is likely to be influenced by age and gender but not by psychological status. From this perspective, the HHS seems to be a better instrument as it is less confounded by patient characteristics. However, this measure is limited, particularly the utility of its range of movement component [22]. The step and balance tests, while easy to implement in a clinical setting, were poorly correlated with other measurements. They capture specific aspects of function and are better suited to complement other assessments of function rather than a stand-alone comprehensive measure. Finally, while it is known that pain influences self-report function [16, 23], it appears that even more objective measures, such as performance tests, are influenced by pain.

Our study is novel as it compared three types of functional measurement tools in the same patient sample, and investigated the association of these measures with patient characteristics. Previous studies comparing fewer measures found moderate to strong correlations between the WOMAC function and performance tests [15, 24, 25] or the HHS [24-26]. Our findings are in agreement with other studies which have found limited evidence of an association between performance tests and components of HHS [22, 27, 28]. This study is not without limitations. The findings were obtained on patients from a single-centre orthopaedic unit limiting their external validity. It also focused on a discrete number of assessment measures and did not include measures such as the Oxford Hip Score [29] or the Hip disability and Osteoarthritis Outcome Score [30]. We were concerned by the potential high burden of completing lengthy questionnaires and attending long research appointments in the ADAPT study. The measures were selected to include a broad range of tools while ensuring that participant burden did not negatively influence data completeness. We preferred to measure separately comorbidities and physical function and therefore we did not consider the Charnley score. The impact of comorbidities on function was assessed using the FCI and a count of the number of joints affected by arthritis. These variables were considered as independent factors in the regression models presented in tables 3 and 4. The participation rate was relatively low but we recruited patients with a wide variation in pre-operative disease severity and any selection bias is expected to impact similarly all measures of function as they were all performed on the same participants.

Conclusion

When evaluating function prior to surgery clinicians and researchers should be aware that each assessment tool captures different aspects of function and that patient characteristics should be taken into account. Psychological status influences the perception of function; patients may be able to do more than they think they can do, and may need encouragement to overcome anxiety. A performance test like a walk-test would provide a more comprehensive assessment of function limitations than a step or balance test, although performance tests are influenced by age.

For the most precise description of functional status a combination of measures should be used. Clinicians should supplement their pre-surgery assessment of function with patient-reported measure to include the patient's perspective.

Disclosure of interests

The authors declare that they have no conflict of interest concerning this article.

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Tables

Table 1. Participant characteristics (N=125)

		n=	%
Surgery type	Primary Replacement	81	64.8
	Revision surgery	44	35.2
Age (year)	median (25th-75th)	125	64.4(57.1, 72.5)
Gender	Female	63	50.4
WOMAC Pain*	mean (95%CI)	124	53.9(50.0, 57.8)
	Missing	1	
Psychological distress‡	Yes	40	32.0
BMI(Kg/m^2)	median (Q1-Q3	125	26.9(24.2, 30.3)
	Overweight	51	40.8
	Obese	33	26.4
Functional Co-Morbidity Index	None	56	46.0
	1 co-morbidity	44	35.9
	≥2 co-morbidities	21	18.1
	Missing	4	
Arthritis	0 joint	26	21.7
	1 joint	30	25.0
	2 joints	23	19.4
	3 joints	18	15.1
	≥4 joints	22	18.8
	Missing	6	
Living Alone	Yes	30	24.6
	Missing	2	
Education	Normal leaving school age or before	67	54.2
	College	28	22.6
	University	28	22.9
	Missing	2	
Working status	Paid or volunteer activity	58	46.4
	Retired	60	48.0
	Unemployed	7	5.6

Category/variable sample sizes (n=) are derived from the overall sample to highlight the extent of missing data. Summary statistics are derived from 10 imputed datasets to account for those missing information.

* Range 0-100, worst to best.

‡ Hospital Anxiety and Depression Scale.

Table 2. Functional measures (N=125)

	Mean	SD*	Min	Max
Patient-reported outcome measure				
WOMAC-function‡	55.3	22.0	0.0	100.0
Clinician-administered measure				
Harris Hip score‡	54.0	17.5	23.2	97.0
Performance tests				
Walking speed▪ (m/sec)	0.9	0.4	0.2	1.7
Stepped 30cm-Achievement	60.4%			
Balance test-Achievement	46.6%			

* Standard Deviation.
‡ Range 0-100, worst to best.
▪ Median and interquartile range reported instead of mean and standard deviation.

Table 3. Correlation coefficients* between functional measures (N=125)

	Harris Hip Score	p-value	WOMAC-function	p-value
WOMAC-function	0.71	<0.0001		
Walking speed	0.67	<0.0001	0.56	<0.0001
30cm-step	0.48	0.0001	0.37	0.0001
Balance	0.38	0.0001	0.27	0.0020

*Spearman rank correlation coefficients except those involving the 30cm-step and balance tests which are point-biserial correlation coefficients. Range: -1 to +1. Strength of correlation: |0.00|-|0.29| = none-little, |0.30|-|0.49| = low, |0.50|-|0.69| = moderate, |0.70|-|0.89| = high, |0.90|-|1.00| = very high.

Table 4. Associations* between patient characteristics and continuous functional measures.

	WOMAC-function				Harris Hip score				Walking speed			
	Unadjusted		**Adjusted**		**Unadjusted**		**Adjusted**		**Unadjusted**		**Adjusted**	
	Coef[95%CI]	P-value	Coef[95%CI]	P-value	Coef[95%CI]	P-value	Coef[95%CI]	P-value	Coef[95%CI]	P-value	Coef[95%CI]	P-value
Age	-0.1[-0.4, 0.3]	0.735			-0.2[-0.5, 0.1]	0.128			-0.01[-0.01, -0.005]	**<0.0001**	**-0.01[-0.01, -0.005]**	**<0.0001**
Gender(ref: male)												
Female	-9.5[-17.2, -1.8]	**0.016**	-6.7[-11.5, -2.0]	**0.006**	-1.7[-7.9, 4.5]	0.585			-0.2[-0.3, -0.1]	**<0.0001**	**-0.2[-0.2, -0.1]**	**<0.0001**
Pain	0.8[0.7, 0.9]	**<0.0001**	0.7[0.5, 0.8]	**<0.0001**	0.5[0.4, 0.6]	**<0.0001**	**0.5[0.4, 0.6]**	**<0.0001**	0.01[0.004, 0.008]	**<0.0001**	**0.01[0.003, 0.007]**	**<0.0001**
Psychological distress	-24.6[-31.8, -17.5]	**<0.0001**	-10.1[-15.8, -4.3]	**0.001**	-12.0[-18.3. -5.7]	**<0.0001**	-0.7[-6.1, 4.8]	0.810	-0.2[-0.3, -0.1]	**0.006**	-0.1[-0.2, 0.1]	0.074
FCI(No co-morbidity)		0.140				0.140				**0.004**		0.282
1	-1.5[-10.3, 7.4]				0.1[-6.9, 7]				-0.1[-0.2, 0.1]		-0.1[-0.4, 0.1]	
≥2	-11.1[-22.4, 0.1]				-8.3[-17.2, 0.5]				-0.2[-0.4, -0.1]		-0.1[-0.2, 0.1]	
BMI(<25)		0.792				0.952				0.789		
[25-30[	-0.5[-9.8, 8.7]				1.1[-6.2, 8.5]				0.0[-0.1, 0.1]			
≥30	-3.3[-13.6, 7.0]				0.9[-7.3, 9.0]				0.1[-0.1, 0.2]			
Arthritis(0 joint)		0.813				0.354				0.111		
1	-3.7[-15.3, 7.9]				-2.6[-11.7, 6.5]				0.0[-0.2, 0.1]			
2	-5.4[-17.8, 7.0]				-8.7[-18.4, 1.0]				-0.2[-0.3, 0.1]			
3	-0.8[-14.1, 12.5]				-3.1[-13.5, 7.2]				-0.1[-0.3, 0.1]			
≥4	-9.9[-22.5, 2.7]				-3.2[-13.0, 6.7]				-0.2[-0.3, 0.1]			
Living alone	-5.9[-15.1, 3.2]	0.203			-6.5[-13.6, 0.7]	0.075			-0.2[-0.3, -0.03]	**0.016**	-0.1[-0.1, 0.1]	0.537
Education(Normal age)		0.820				0.951				0.653		
College	-2.7[-12.6, 7.3]				0.5[-7.4, 8.4]				0.1[-0.1, 0.2]			
Degree or above	-2.4[-12.4, 7.5]				-0.9[-8.8, 7.0]				0[-0.1, 0.2]			
Working status(Active)		0.076				**0.008**		**0.008**		**0.003**		0.591
Retired	-3.2[-11.1, 4.8]				-7.4[-13.6, -1.3]		-7.3[-11.8, -2.7]		-0.2[-0.3, -0.1]		-0.1[-0.1, 0.1]	
Unemployed	-19.9[-37.2, -2.6]				-17.7[-31.1, -4.3]		-4.8[-15.0, 5.4]		-0.1[-0.4, 0.1]		-0.1[-0.3, 0.1]	

* Linear regression coefficients derived from imputed datasets.

Table 5. Hip- Associations* between patient characteristics and dichotomous functional measures.

	30cm-step test				Balance test			
	Unadjusted		**Adjusted**		**Unadjusted**		**Adjusted**	
	RR[95%CI]	P-value	RR[95%CI]	P-value	RR[95%CI]	P-value	RR[95%CI]	P-value
Age	0.98[0.97, 0.99]	**0.001**	0.98[0.97, 0.99]	**0.010**	0.96[0.95, 0.98]	**<0.0001**	0.97[0.95, 0.99]	**0.008**
Gender(ref: male)								
Female	0.67[0.49, 0.90]	**0.008**	0.71[0.54, 0.93]	**0.012**	0.65[0.44, 0.96]	**0.030**	0.74[0.50, 1.08]	0.113
Pain	1.01[1.00, 1.02]	**0.007**	1.01[1.00, 1.01]	**0.030**	1.01[1.00, 1.02]	**0.021**	1.01[1.00, 1.02]	**0.027**
Psychological distress	0.90[0.66, 1.25]	0.543			0.96[0.63, 1.44]	0.831		
FCI(No co-morbidity)		**0.009**		**0.020**		0.060		
1	0.78[0.58, 1.04]		0.78[0.59, 1.03]		0.76[0.5, 1.14]			
≥2	0.38[0.19, 0.76]		0.51[0.30, 0.89]		0.42[0.19, 0.93]			
BMI(<25)		0.758				0.130		
[25-30[	1.02[0.74, 1.41]				1.13[0.75, 1.68]			
≥30	0.88[0.59, 1.32]				0.62[0.34, 1.14]			
Arthritis(0 joint)		0.383				0.448		
1	1.10[0.71, 1.69]				1.34[0.77, 2.32]			
2	0.75[0.42, 1.34]				0.82[0.40, 1.69]			
3	1.22[0.78, 1.92]				1.18[0.62, 2.26]			
≥4	1.10[0.70, 1.74]				0.97[0.49, 1.90]			
Living alone	0.69[0.45, 1.07]	0.099			0.47[0.24, 0.91]	**0.025**	0.61[0.32, 1.15]	0.125
Education(Normal age)		0.556				**0.028**		0.083
College	1.19[0.85, 1.65]				1.77[1.13, 2.77]		0.85[0.48, 1.50]	
Degree or above	1.00[0.68, 1.47]				1.66[1.05, 2.64]		1.06[0.56, 1.98]	
Working status(Active)		**0.017**		0.365		**0.005**		0.842
Retired	0.66[0.49, 0.90]		0.95[0.66, 1.36]		0.48[0.31, 0.75]		1.55[1.02, 2.35]	
Unemployed	0.58[0.24, 1.38]		0.56[0.24, 1.30]		0.92[0.47, 1.81]		1.47[0.96, 2.24]	

* Modified Poisson regression coefficients derived from imputed datasets.