The Trapeziometacarpal Arthrosis Symptoms and Disability Questionnaire: Development and Preliminary Validation

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Abstract

Background: Symptoms and disability at the trapeziometacarpal (TMC) joint are typically assessed with general measures that may not be able to accurately discriminate between TMC arthrosis-specific versus other hand and arm condition concerns. The objective was to develop and preliminary validate the Trapeziometacarpal Arthrosis Symptoms and Disability (TASD) questionnaire designed to assess symptoms and disability at the TMC joint. **Methods:** English-speaking patients (50 years or older) were enrolled in 1 of 2 samples (sample 1, 64 patients specifically presented for treatment of TMC arthrosis; sample 2, 64 patients received an incidental diagnosis of previously undiagnosed TMC arthrosis when presenting for treatment of another, not thumb-related condition). Principal component analysis identified the number of subscales (factors) and factor loadings of all items (ie, structural construct validity). Internal consistency was assessed with Cronbach alpha. Convergent, discriminant, and known-groups construct validity of the subscales were assessed with Spearman correlations. **Results:** The final TASD has 12 items and 2 subscales, as confirmed by principal component analysis: symptoms (7 items) and disability (5 items). The subscales' internal consistency was good to excellent in both samples. The TASD showed good convergent validity as evidenced by moderate to strong correlations between both subscales and upper extremity disability, pain intensity, depression, self-efficacy, and key pinch strength (sample 1). The TASD also showed good discriminant, and good known-groups validity. **Conclusions:** The concise TASD is useful in assessing symptoms and disability related to TMC arthrosis, has a simple scoring system and administration mode (self-administered), and is free.

Keywords: disability, internal consistency, measure, osteoarthritis, symptoms, trapeziometacarpal arthrosis, validation

Introduction

Trapeziometacarpal (TMC) arthrosis is an expected part of normal human aging.^{5,34} Symptoms and disability associated with TMC arthrosis are typically measured with upper extremity-specific disability questionnaires such as the Disabilities of the Arm, Shoulder and Hand (DASH), its shorter version, the *QuickDASH*, the Patient-Rated Wrist (Hand) Evaluation (PRW(H)E), and the Michigan Hand Questionnaire (MHQ), or with osteoarthritis specific measures such as the Australian/Canadian (AUSCAN) Osteoarthritis Hand Index.³¹

Although widely used and validated for use in patients with TMC arthrosis,^{30,31} the aforementioned questionnaires were not developed specifically for TMC arthrosis and face several limitations. For example, the DASH and *QuickDASH* scores do not discriminate between symptoms/disability associated with TMC arthrosis and other hand, arm or shoulder function/disability concerns.³¹ The 15-item PRW(H)E addresses this issue by including 4 items about difficulty with usual activities (personal care, household work, work/

occupation, and recreational activities) during the past week that should be rated in comparison with the time before the wrist problem started; however, a range of other problems that are not TMC arthrosis related could very well affect response to these items.²⁸ These three questionnaires also reflect both the affected and the non-affected limb,²⁰ which can confound the total score. In contrast, the MHQ is a hand-specific outcomes questionnaire that adjusts for hand dominance, and can distinguish between the left and right hand.¹¹

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However, responsiveness of the MHQ is only validated for surgically treated TMC arthrosis patients,³⁰ and can also capture symptoms and disability due to other hand problems. The AUSCAN Osteoarthritis Hand Index⁷ was developed specifically for hand arthrosis but is not freely available and has to be purchased. The AUSCAN Osteoarthritis Hand Index score is significantly more responsive for patients with TMC arthrosis alone than for patients with additional involvement of other osteoarthritic hand joints.²⁸ Although Citron et al developed the Nelson Hospital Score, a TMC arthrosis-specific questionnaire, its goal was to assess symptoms and disability after surgery,¹² and has not been validated for use with general TMC arthrosis patients. In addition, the Nelson Hospital Score has poor methodological quality,³¹ lacks factor analysis to confirm the number of factors (subscales) and related items, and has rarely been used.^{12,14,15,38}

A TMC joint-specific questionnaire might be more responsive (able to detect clinically important change but distinguish it from measurement error) than a hand or upper extremity questionnaire.³¹ Furthermore, a TMC joint-specific questionnaire might also help discriminate symptoms and disability related to TMC arthrosis from symptoms and disability due to other hand, arm, or shoulder problems. This is important for clinical practice, as it can help differentiate between symptoms and disability from TMC arthrosis and other comorbid hand or upper extremity conditions, and can help facilitate pre-TMC arthrosis-specific and post-TMC arthrosis-specific treatment effects.

We followed evidence-based recommendations for questionnaire development,^{2,37} and set out to develop a questionnaire that measures symptoms and disability in patients who present to orthopedic hand practices with TMC arthrosis either as chief complaint or as an incidental finding. The Trapeziometacarpal Arthrosis Symptoms and Disability (TASD) questionnaire aims to aid in the evaluation of severity of symptoms and disability and also allow for before and after intervention comparison.

Our purpose was to (1) develop the (TASD) questionnaire, designed to assess symptoms and disability at the TMC joint; (2) test structural construct validity; (3) test internal consistency; and (4) test convergent, discriminant, and known-groups construct validity.

Materials and Methods

Participants were 128 patients who specifically presented for treatment of TMC arthrosis-related symptoms (sample 1, $n = 64$) or who received an incidental diagnosis of previously undiagnosed TMC arthrosis when presenting for treatment of another, not thumb-related condition (sample 2, $n = 64$). Recruitment occurred between March 2012 and July 2013. We used data from a previously published cross-sectional study which compared TMC arthrosis-related disability and symptoms in the 2 samples of patients.⁶ This study was approved by our human research committee.

All patients were fluent in English, 50 years of age or older, and received a diagnosis of TMC arthrosis based on crepitation with axial pressure and circumduction of the TMC joint by one of three orthopaedic hand surgeons. Patients did not have a history of thumb injury and/or surgery for TMC arthrosis, and were not currently pregnant (institutional review board mandated).

Participants completed a battery of demographics, the newly developed TASD questionnaire, the *QuickDASH*³ to measure disability, the Numerical Rating Scale (NRS) to measure pain intensity at the base of the thumb(s), the 9-item Patient Health Questionnaire (PHQ-9)²⁴ to measure depression, and the Pain Self-Efficacy Questionnaire (PSEQ)³² to measure pain self-efficacy. A research assistant not involved in patient care measured grip and pinch strength of both hands and results are reported as the percentage of strength calculation (involved/noninvolved hand or most involved/least involved hand for bilateral symptoms).

We developed the TASD questionnaire from an initial pool of items generated with help from patients, physicians and textbooks,^{1,26} and narrowed the initial large pool of items to 12 by eliminating redundant or unclear items. Emphasis was placed on using simple and unambiguous wording of items and responses, and ensuring that the questionnaire is not too long and bothersome for patients. Gender-specific items and items that only applied to the dominant hand were excluded. The final questionnaire comprised 12 items on 2 subscales measuring symptoms (7 items) and disabilities (difficulty with thumb-related activities; 5 items) during the past 2 weeks. Symptom severity is measured on a 5-point Likert scale ranging from 1 (none) to 5 (extreme), and severity of disability is measured on a 5-point Likert scale ranging from 1 (no difficulty) to 5 (unable). The score is the sum of all item responses divided by the number of item responses, subtracting 1, and finally multiplied by 25. The scoring is identical to that of the (*Quick*)DASH.²³ The total score and subscale scores can range from 0 to 100 points with a higher score indicating more TMC arthrosis-related symptoms and/or disability. The final questionnaire is presented in Figure 1. Patients were asked to complete the questionnaire for their affected thumb or both thumbs in case of bilateral symptoms (in case they were symptomatic; asymptomatic patients responded “none” or “no difficulty” to the questions). No other explanations were given before patients filled out the TASD.

The *QuickDASH*³ is a shortened version of the 30-item DASH outcome measure questionnaire.²⁰ The *QuickDASH* has 11 items, each answered on a 5-point Likert scale that measures physical function and symptoms in persons with any or multiple musculoskeletal disorders of the upper limb. Scores range from 0 to 100 with higher scores indicating greater disability.²⁰

The NRS is an 11-point ordinal scale with 0 representing “no pain” and 10 representing the “worst possible pain” that measures the overall pain intensity at the base of the thumb(s).¹⁸

Please rate the following symptoms.

	None	Mild	Moderate	Severe	Extreme
1. Pain at the base of your thumb(s) at rest	1	2	3	4	5
2. Pain at the base of your thumb(s) during activities	1	2	3	4	5
3. Tenderness at the base of your thumb(s)	1	2	3	4	5
4. Swelling at the base of your thumb(s)	1	2	3	4	5
5. Stiffness of your thumb(s)	1	2	3	4	5
6. Decreased range of motion of your thumb(s)	1	2	3	4	5
7. Decreased strength when pinching or grasping objects	1	2	3	4	5

Please rate how much difficulty you have had doing the following activities.

	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
8. Open a tight or new jar	1	2	3	4	5
9. Turn a key	1	2	3	4	5
10. Turn a door knob	1	2	3	4	5
11. Pull a zipper	1	2	3	4	5
12. Grasp larger objects (glass, bottle, book, etc.)	1	2	3	4	5

Figure 1. Trapeziometacarpal Arthrosis Symptoms and Disability (TASD) questionnaire.

The PHQ-9²⁴ is a measure of depressive symptoms. The PHQ-9 has 9 items answered on a 4-point Likert scale from 0 (not at all) to 3 (nearly every day).²⁴ Higher scores indicate more depressive symptoms.²⁴

The PSEQ³² is a measure of pain self-efficacy. The PSEQ consists of 10 items scored from 0 (not at all confident) to 6 (completely confident). The total score is calculated by adding all items such that it can range from 0 to 60.³² Lower scores indicate less pain self-efficacy.³²

Statistical Analysis

Our sample size ($n = 64/\text{group}$) was over the minimum criteria of $n = 50$ established by De Winter¹⁶ and over the 4 subjects per variable ratio suggested by MacCallum²⁷ for factor analyses with good to high communality. Data were not normally distributed according to the Shapiro-Wilk test; therefore, nonparametric tests were used to assess the relationship between 2 variables.

Continuous data are presented as median and interquartile range. The Pearson chi-square test evaluated differences between categorical variables and the Fisher exact test was used instead when the minimum expected cell frequency was less than 5. The Mann-Whitney U test assessed differences in continuous or ordinal variables between two groups. The Kruskal-Wallis test determined differences in continuous or ordinal variables between more than 2 groups.

An effect size (r) was calculated from the Z value of the Mann-Whitney U test for tests with $P < .05$.

Regression prediction plus error imputation was used for missing or invalid questionnaires, scales, or separate measurements. This method was used for the PHQ-9 score (1 missing), key pinch strength (2 missing), and grip strength (2 missing). There were no missing items on the TASD.

To test the structural construct validity of the TASD, principal component analysis identified the number of distinct factors (subscales) accounting for the variance in scores and the subset of questions associated with each factor. For example, questions addressing pain might form one subset along with questions addressing strength, whereas questions influenced more by deformity or stiffness might form another subset. The Bartlett sphericity test and Kaiser-Meyer-Olkin measure tested the suitability of the data for the structural construct validity analyses. A statistically significant result of the Bartlett sphericity test indicates that the items are correlated with each other (nondiagonal variance-covariance matrix).¹⁷ A Kaiser-Meyer-Olkin test score of more than 0.5 indicates an acceptable degree of correlation among the questions.^{17,22}

The Eigenvalue of a factor is a measure of the amount of variance explained by the specific factor/subgroup of questions (dividing the Eigenvalue by the total number of questionnaire items gives the total variance accounted for by the Eigenvalue). An Eigenvalue greater than 1 indicates that the

factor contains more information than the average item and is a common criterion for deciding the number of discrete factors (subgroups of questions) to include.²¹ Scree plots are plots of the Eigenvalues (y-axis) in a descending order from left to right (on the x-axis) that help determine the number of separate factors captured by the questionnaire. Factors to the right of the point where the plot stops declining (begins to plateau) are excluded.¹⁰

Oblique rotation determined which items were associated with a factor/subscale by allowing correlated/nonperpendicular factor axes (dimensions) as the symptoms and disability subscale were expected to correlate with one another. Items that had a rotated factor loading of >0.4 onto one of the factors were considered important.³⁵

Cronbach alpha correlation coefficient assessed internal consistency.¹³ If a question contributes to reduced internal consistency of the subscale (Cronbach alpha is higher if item is deleted), it should be deleted.

Construct validity was assessed by examining convergent validity (eg, correlations of TASD with questionnaires that measure similar constructs, or that are expected to be correlated with this measure), discriminant validity (eg, correlations of TASD with measures that it is not supposed to be correlated with), and known-groups validity (eg, demonstrated when TASD can discriminate between the sample presenting for care of TMC arthrosis and the other sample with an incidental diagnosis of TMC arthrosis). Spearman correlation coefficients were used to assess the relationship between the TASD subscales and the other measures (*QuickDASH*, ordinal pain scale, PHQ-9, PSEQ, pinch and grip strength).

Characteristics of Study Population

More women than men were enrolled in sample 1 compared with sample 2 (47 of 64 were female in sample 1 vs 34 of 64 in sample 2, $P = .017$). Characteristics of and comparison between patients of the two samples are shown in Table 1.

Results

Among patients presenting for care of TMC arthrosis, the Bartlett sphericity test was statistically significant ($P < .001$) and Kaiser-Meyer-Olkin test score was 0.86. In the cohort consisting of patients with incidental TMC arthrosis, the Bartlett sphericity test was also statistically significant ($P < .001$) and the Kaiser-Meyer-Olkin test score was 0.75. Taken together, these indicate that a factor analysis is meaningful with these data.^{17,22}

Principal component analysis of the total TASD scale among patients presenting for TMC arthrosis and patients with incidental TMC arthrosis identified 2 subscales (factors; Eigenvalue for subscale 1: 6.0 [sample 1] and 5.7 [sample 2]; Eigenvalue for subscale 2: 1.7 [sample 1] and

2.4 [sample 2]) that explained 64% (50% [Eigenvalue 1] and 14% [Eigenvalue 2]) and 67% (47% [Eigenvalue 1] and 20% [Eigenvalue 2]), respectively, of the total variance in scores. In both samples, the scree plots leveled off after 2 factors also indicating that the TASD is composed of 2 subscales. The second factor analysis, for which 2 retained subscales were specified, showed that all items clearly associated with (loaded on) one of the two subscales they were intended for, so one subset of questions was associated with the symptom subscale and the other subset with the disability subscale (Table 2). However, the 2 items "Pain at the base of your thumb(s) during activities" and "Decreased strength when pinching or grasping objects" of the symptom subscale associated more with the disability than the symptom subscale in the sample with patients presenting for TMC arthrosis but these 2 items were only associated with the symptom subscale in the other sample.

In the sample with patients presenting for care of TMC arthrosis, internal consistency of the symptom subscale and the disability subscale were both good (Cronbach $\alpha = 0.86$, and Cronbach $\alpha = 0.88$, respectively; Table 3). In the sample consisting of patients with incidental TMC arthrosis, internal consistency of the symptom subscale was excellent (Cronbach $\alpha = 0.91$) and good for the disability subscale (Cronbach $\alpha = 0.80$). Only the item "Open a tight or new jar" minimally reduced the internal consistency of the disability subscale but because the change was so minimal, the item was not deleted (Table 3).

The TASD showed overall good convergent validity. Both subscales were significantly correlated with the DASH and PHQ-9 with moderate to high coefficients in both samples. The symptom and disability subscale were both significantly, moderately correlated with pain intensity in both samples. The PSEQ and key pinch strength correlated moderately with the disability subscale and less than moderately, although significantly, with the symptom subscale in patients presenting for care of TMC arthrosis. The PSEQ also correlated weakly but significantly with the disability subscale in patients with an incidental diagnosis of TMC arthrosis (Table 4).

The TASD showed good discriminant validity as evidenced by a (very) weak, nonsignificant correlation between both subscales and grip strength in both samples (Table 4).

The TASD showed good known-groups validity as evidenced by an on average higher than 37-point difference in both the total and subscales scores between the 2 samples ($P < .001$) with higher scores in patients presenting for care of TMC arthrosis (Table 5).

Discussion

The goal of this study was to develop the TASD, a questionnaire specific for symptoms and disabilities related to TMC arthrosis, and to determine internal consistency and perform

Table 1. Presenting for Care of TMC Arthrosis Versus Incidental TMC Arthrosis (N = 128).

Parameter	Sample				P value
	Care for TMC arthrosis (n = 64)		Incidental TMC arthrosis (n = 64)		
	Median	IQR	Median	IQR	
Age, y	65	58-70	65	61-75	.17
Education, y	16	14-18	14	12-16	.0085
TASD questionnaire	44	30-58	2	0.0-12	<.001
Symptom subscale	43	29-60	0.0	0.0-7.1	<.001
Disability subscale	48	30-65	5.0	0.0-15	<.001
QuickDASH	33	20-48	14	5.1-25	<.001
Pain intensity scale	6.0	5.0-7.0	0.0	0.0-0.0	<.001
PHQ-9	2.0	0.0-7.0	1.0	0.0-2.8	.0054
PSEQ	52	40-58	59	56-60	<.001
Key pinch strength (%)	85	78-97	103	87-112	<.001
Tip pinch strength (%)	88	75-97	100	89-114	<.001
Palmar pinch strength (%)	89	77-103	101	85-110	.0065
Grip strength (%)	93	80-105	96	82-115	.20
	No.	%	No.	%	
Sex					.017
Male	17	26.6	30	46.9	
Female	47	73.4	34	53.1	
History of joint diseases					.018
No	21	32.8	37	57.8	
Osteoarthritis	38	59.4	24	37.5	
Osteoarthritis and inflammatory arthritis	5	7.8	3	4.7	

Note. Numbers in bold indicate significant *P* values ($P < .05$). TMC, trapeziometacarpal; IQR, interquartile range; TASD, Trapeziometacarpal Arthrosis Symptoms and Disability; QuickDASH, short version of Disabilities of the Arm, Shoulder and Hand questionnaire; PHQ-9, 9-item Patient Health Questionnaire; PSEQ, Pain Self-Efficacy Questionnaire; NS, not significant.

a preliminary validity analysis in patients who presented for care of TMC arthrosis (sample 1) and who received an incidental diagnosis of TMC arthrosis (sample 2). The TASD is concise, has a simple scoring system and administration mode (self-administered), and it is free. The measure was found to have high internal consistency reliability, good structural validity, and good convergent, discriminant, and known-groups construct validity.

This study has a number of limitations. First, the sample of patients presenting for care of TMC arthrosis mostly comprised of women (73%) but the sample containing patients with incidental TMC arthrosis was almost equally divided (53% women). This may limit the generalizability of our results; however, most patients presenting for treatment of TMC arthrosis are women. Second, we did not evaluate test-retest reliability or the responsiveness of our questionnaire. Finally, the convergent construct validity of the TASD was good but not excellent, as the symptom subscale correlated significantly but not strongly ($\rho < 0.6$) with

the pain intensity scale in both samples. However, the DASH correlated strongly ($\rho > 0.6$) with the disability subscale in both samples. The Nelson Hospital Score correlated strongly with pain intensity ($r = 0.63$ at rest, and $r = 0.81$ in use).¹² Another study showed a very strong correlation between the Nelson Hospital Score and the QuickDASH and pain intensity ($r = .9$ and $r = .8$, respectively).³⁸ It seems obvious that the correlations between the TASD subscales and pain intensity are not so high as only 2 out of 12 TASD questions are directly related to pain and the other items are related to other TMC arthrosis-related symptoms and thumb-related activities. In addition, the DASH is unspecific for the thumb and the highest correlation between the DASH and TASD was with the disability subscale, as hypothesized. Convergent validity should be tested in further studies using more specific measures for comparison, for example, the Nelson Hospital Score.

The TASD assesses TMC arthrosis-specific symptoms and disability in patients who present to an orthopedic

Table 2. Factor Loadings on the Symptoms and Disability Subscales of the TASD Questionnaire (n = 128).

Item	Sample			
	Care for TMC arthrosis (n = 64)		Incidental TMC arthrosis (n = 64)	
	Factor 1	Factor 2	Factor 1	Factor 2
Symptom subscale				
Pain at the base of your thumb(s) at rest	0.67		0.93	
Pain at the base of your thumb(s) during activities	0.25	0.58	0.94	
Tenderness at the base of your thumb(s)	0.78		0.86	
Swelling at the base of your thumb(s)	0.83		0.58	
Stiffness of your thumb(s)	0.87		0.78	
Decreased range of motion of your thumb(s)	0.61	0.21	0.92	
Decreased strength when pinching or grasping objects	0.36	0.57	0.80	
Disability subscale				
Open a tight or new jar		0.74	0.42	0.44
Turn a key	-0.23	0.97		0.82
Turn a door knob		0.93		0.88
Pull a zipper	0.21	0.74		0.88
Grasp larger objects (glass, bottle, book, etc)	0.27	0.63		0.66

Note. Values in bold indicate the loading of the item. TASD, Trapeziometacarpal Arthrosis Symptoms and Disability; TMC, trapeziometacarpal.

Table 3. Internal Consistency of the TASD Questionnaire (n = 128).

	Sample			
	Care for TMC arthrosis (n = 64)		Incidental TMC arthrosis (n = 64)	
	Corrected item-total correlation	Cronbach α if item deleted	Corrected item-total correlation	Cronbach α if item deleted
Symptom subscale				
Pain at the base of your thumb(s) at rest	.50	.86	.83	.91
Pain at the base of your thumb(s) during activities	.54	.85	.84	.89
Tenderness at the base of your thumb(s)	.78	.82	.81	.90
Swelling at the base of your thumb(s)	.61	.85	.56	.92
Stiffness of your thumb(s)	.75	.82	.77	.90
Decreased range of motion of your thumb(s)	.62	.84	.82	.89
Decreased strength when pinching or grasping objects	.63	.84	.71	.91
Disability subscale				
Open a tight or new jar	.59	.89	.49	.83
Turn a key	.78	.85	.67	.73
Turn a door knob	.83	.83	.72	.73
Pull a zipper	.74	.86	.63	.75
Grasp larger objects (glass, bottle, book, etc)	.67	.87	.55	.77

Note. TASD, Trapeziometacarpal Arthrosis Symptoms and Disability; TMC, trapeziometacarpal.

surgical practice with symptoms of TMC arthrosis either as chief complaint or in conjunction with other hand or upper extremity-specific conditions. The TASD can be very useful in clinical and research practice, to help differentiate symptoms of TMC arthrosis from other confounding hand

or upper extremity-specific illnesses, aid in symptom management, and help monitor change and treatment effects.

Factor analysis showed that the TASD has 2 subscales, which supports its structural construct validity. In general, symptom items associated with (loaded on) one subscale

Table 4. Spearman Correlations Between TASD Questionnaire and Other Measurements (n = 128).

Parameter	Sample							
	Care for TMC arthrosis (n = 64)				Incidental TMC arthrosis (n = 64)			
	Symptom subscale		Disability subscale		Symptom subscale		Disability subscale	
	Correlation	P value	Correlation	P value	Correlation	P value	Correlation	p value
QuickDASH	.62	<.001	.78	<.001	.41	<.001	.62	<.001
Pain intensity scale	.41	<.001	.56	<.001	.57	<.001	.40	<.001
PHQ-9	.46	<.001	.54	<.001	.38	.0020	.57	<.001
PSEQ	-.35	.0041	-.48	<.001	-.18	.16	-.25	.049
Key pinch strength	-.31	.013	-.43	<.001	-.14	.26	-.014	.91
Grip strength	-.19	.14	-.20	.11	.0043	.97	.018	.89

Note. Numbers in bold indicate significant *P* values (*P* < .05). TASD, Trapeziometacarpal Arthrosis Symptoms and Disability; TMC, trapeziometacarpal; QuickDASH, short version of Disabilities of the Arm, Shoulder and Hand questionnaire; PHQ-9, 9-item Patient Health Questionnaire; PSEQ, Pain Self-Efficacy Questionnaire; NS, not significant.

Table 5. Differences in Mean Scores of TASD Questionnaire Between Samples (n = 128).

	Sample		P value
	Care for TMC arthrosis (n = 64)	Incidental TMC arthrosis (n = 64)	
	Mean (SD)	Mean (SD)	
TASD questionnaire	46 (20)	7.6 (11)	<.001
Symptom subscale	44 (21)	5.2 (12)	<.001
Disability subscale	48 (23)	11 (14)	<.001

Note. Numbers in bold indicate significant *P* values (*P* < .05). TASD, Trapeziometacarpal Arthrosis Symptoms and Disability; TMC, trapeziometacarpal.

(symptom subscale) and the disability items with the other subscale (disability subscale). Items assessing “Pain at the base of the thumb during activity” and “Decreased strength when pinching” better associated with the disability subscale in patients presenting for care of TMC arthrosis but only associated with the symptom subscale in the other sample. As both items assess symptoms during activity, some overlap is to be expected. This may also reflect the different nature of the 2 samples with the same diagnosis. Patients who present specifically for treatment of TMC arthrosis do so because of disability, whereas patients who get the diagnosis incidentally may experience the symptoms, albeit milder, but not the disability and hence may not present for treatment.

Internal consistency was good for the symptom and disability subscale in both cohorts. Internal consistency of the symptom subscale was even excellent in the sample with incidental diagnosis of TMC arthrosis (Cronbach α = 0.91); however, it has been argued that Cronbach α should never be higher than 0.9 because it likely indicates item

redundancy.³⁶ The number of items on a scale strongly affects the alpha score.^{19,36} As the symptom subscale contains 7 items, this alpha score unlikely indicates item redundancy.

The convergent validity of the TASD questionnaire was suboptimal considering the less than 0.6 correlation between the symptom subscale and pain scale in both samples, but the correlation was strong with the DASH. As hypothesized, key pinch strength negatively and moderately correlated with the disability subscale. Discriminant validity was as hypothesized; grip strength had less than a weak correlation (<0.4) with the TASD in both samples. Citron et al also found that their validated Nelson Hospital Score, specifically developed to assess recovery after surgery in patients with TMC arthrosis, poorly correlated with grip strength but moderately correlated with key pinch strength.¹² The TASD questionnaire was expected to show at least a moderate correlation with depression as it did as previous studies showed a correlation between the DASH or QuickDASH and depression in patients with symptomatic TMC arthrosis.^{4,25,29,33} In

addition, the T ASD was expected to show a stronger correlation with self-efficacy than it did as the *QuickDASH* and pain self-efficacy strongly correlated in patients with other common hand conditions. Known-groups validity was confirmed. That patients with an incidental diagnosis of TMC arthrosis had lower scores compared with patients presenting for care of TMC arthrosis makes sense as incidentally diagnosed patients are mostly asymptomatic, and/or well adjusted to their symptoms.

Additional studies are needed to assess the responsiveness of the T ASD subscales after nonoperative and operative treatment, evaluate how well the T ASD discriminates between patients with TMC arthrosis and another condition, and determine its test-retest reliability. Also, future studies of unrelated and larger samples are needed to cross-validate the psychometric properties and factor structure of this questionnaire, and compare it with other questionnaires validated for use in TMC arthrosis. This preliminary validation study shows that our T ASD questionnaire comprising 2 subscales is internally consistent and has good preliminary construct validity and is useful in assessing symptoms and disability related to TMC arthrosis.

Authors' Note

This work was performed at the Orthopaedic Hand and Upper Extremity Service, Harvard Medical School, Massachusetts General Hospital, Yawkey Center, Suite 2100, 55 Fruit Street, Boston, MA 02114, USA.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

1. Barron OA, Catalano LW. Thumb basal joint arthritis. In: Wolfe SW, Hotchkiss RN, Pederson WC, Kozin SH, eds. *Green's Operative Hand Surgery*, 6th ed. Philadelphia, PA: Elsevier, 2010:407-427.
2. Beaton DE, Boers M, Tugwell P. Assessment of health outcomes. In: Firestein GS, Budd RC, Gabriel SE, McInnes IB, O'Dell JR, eds. *Kelley's Textbook of Rheumatology*. 9th ed. Philadelphia, PA: Elsevier, 2013:462-475.
3. Beaton DE, Wright JG, Katz JN, et al. Development of the QuickDASH: comparison of three item-reduction approaches. *J Bone Joint Surg Am*. 2005;87:1038-1046.
4. Becker SJ, Bot AG, Curley SE, et al. A prospective randomized comparison of neoprene vs thermoplast hand-based thumb spica splinting for trapeziometacarpal arthrosis. *Osteoarthritis Cartilage*. 2013;21:668-675.
5. Becker SJ, Briet JP, Hageman MG, et al. Death, taxes, and trapeziometacarpal arthrosis. *Clin Orthop Relat Res*. 2013;471:3738-3744.
6. Becker SJ, Makarawung DJ, Spit SA, et al. Disability in patients with trapeziometacarpal joint arthrosis: incidental versus presenting diagnosis. *J Hand Surg Am*. 2014;39:2009-2015. e2008.
7. Bellamy N, Campbell J, Haraoui B, et al. Dimensionality and clinical importance of pain and disability in hand osteoarthritis: Development of the Australian/Canadian (AUSCAN) Osteoarthritis Hand Index. *Osteoarthritis Cartilage*. 2002;10:855-862.
8. Bot AG, Nota SP, Ring D. The creation of an abbreviated version of the PSEQ: the PSEQ-2. *Psychosomatics*. 2014;55:381-385.
9. Briet JP, Bot AG, Hageman MG, et al. The Pain Self-Efficacy Questionnaire: validation of an abbreviated two-item questionnaire. *Psychosomatics*. 2014;55:578-585.
10. Cattell RB. The Scree test for the number of factors. *Multivariate Behav Res*. 1966;1:245-276.
11. Chung KC, Pillsbury MS, Walters MR, et al. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. *J Hand Surg Am*. 1998;23:575-587.
12. Citron N, Hulme CE, Wardle N. A self-administered questionnaire for basal osteoarthritis of the thumb. *J Hand Surg Eur Vol*. 2007;32:524-528.
13. Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika*. 1951;16:297-334.
14. De Smet L, Vandenberghe L, Degreef I. Long-term outcome of trapeziectomy with ligament reconstruction and tendon interposition (LRTI) versus prosthesis arthroplasty for basal joint osteoarthritis of the thumb. *Acta Orthop Belg*. 2013;79:146-149.
15. De Smet L, Vandenberghe L, Didden K, et al. Outcome of simultaneous surgical treatment of hyperextension of metacarpophalangeal and basal joint osteoarthritis of the thumb. *Acta Orthop Belg*. 2013;79:514-516.
16. De Winter JCF, Dodou D, Wieringa PA. Exploratory factor analysis with small sample sizes. *Multivariate Behav Res*. 2009;44:147-181.
17. Dziuban CD, Shirkey EC. When is a correlation matrix appropriate for factor analysis? Some decision rules. *Psychol Bull*. 1974;81:358-361.

18. Farrar JT, Young JP Jr, LaMoreaux L, et al. Clinical importance of changes in chronic pain intensity measured on an 11-point Numerical Pain Rating Scale. *Pain*. 2001;94:149-158.
19. Field AP. Exploratory factor analysis. In: Carmichael, M., ed. *Discovering Statistics Using IBM SPSS Statistics: And Sex and Drugs and Rock 'n' Roll*. 4th ed. London, England: Sage; 2013:709-710.
20. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). *Am J Ind Med*. 1996;29:602-608.
21. Kaiser HF. The application of electronic computers to factor analysis. *Educ Psychol Meas*. 1960;20:141-151.
22. Kaiser HF. An index of factorial simplicity. *Psychometrika*. 1974;39:31-36.
23. Kennedy CA, Beaton DE, Solway S, et al. *Disabilities of the Arm, Shoulder and Hand (DASH). The DASH and QuickDASH Outcome Measure User's Manual*. 3rd ed. Toronto, Ontario: Institute for Work & Health; 2011.
24. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16:606-613.
25. Lozano-Calderon SA, Souer JS, Jupiter JB, et al. Psychological differences between patients that elect operative or nonoperative treatment for trapeziometacarpal joint arthrosis. *Hand*. 2008;3:271-275.
26. Lubahn JD, Williams DP. The hand and wrist. In: Greene WB, eds. *Netter's Orthopaedics*. 1st ed. Philadelphia, PA, Saunders, Elsevier; 2006.
27. MacCallum RC, Widaman KF, Preacher KJ, et al. Sample size in factor analysis: the role of model error. *Multivariate Behav Res*. 2001;36:611-637.
28. MacDermid JC, Wessel J, Humphrey R, et al. Validity of self-report measures of pain and disability for persons who have undergone arthroplasty for osteoarthritis of the carpometacarpal joint of the hand. *Osteoarthritis Cartilage*. 2007;15:524-530.
29. Makarawung DJ, Becker SJ, Bekkers S, et al. Disability and pain after cortisone versus placebo injection for trapeziometacarpal arthrosis and de Quervain syndrome. *Hand*. 2013;8:375-381.
30. Marks M, Audige L, Herren DB, et al. Measurement properties of the German Michigan Hand Outcomes Questionnaire in patients with trapeziometacarpal osteoarthritis. *Arthritis Care Res*. 2014;66:245-252.
31. Marks M, Schoones JW, Kolling C, et al. Outcome measures and their measurement properties for trapeziometacarpal osteoarthritis: a systematic literature review. *J Hand Surg Eur Vol*. 2013;38:822-838.
32. Nicholas MK. The Pain Self-Efficacy Questionnaire: Taking pain into account. *Eur J Pain*. 2007;11:153-163.
33. Nickel MC, Lindenhovius AL, Watson JB, et al. Correlation of DASH and QuickDASH with measures of psychological distress. *J Hand Surg Am*. 2009;34:1499-1505.
34. Sodha S, Ring D, Zurakowski D, et al. Prevalence of osteoarthritis of the trapeziometacarpal joint. *J Bone Joint Surg Am*. 2005;87:2614-2618.
35. Stevens JP. *Applied Multivariate Statistics for the Social Sciences*. 4th ed. Mahwah, NJ: Lawrence Erlbaum; 2002.
36. Streiner DL. Starting at the beginning: an introduction to coefficient alpha and internal consistency. *J Pers Assess*. 2003;80:99-103.
37. Terwee CB, Mokkink LB, Knol DL, et al. Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. *Qual Life Res*. 2012;21:651-657.
38. Vandenbergh L, Degreef I, Didden K, et al. Long term outcome of trapeziectomy with ligament reconstruction/tendon interposition versus thumb basal joint prosthesis. *J Hand Surg Eur Vol*. 2013;38:839-843.