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ORIGINAL ARTICLE

Reliability and validity of Turkish version of the patient rated tennis elbow evaluation

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Abstract The objective of this study was to test the reliability of the Turkish version of PRTEE (PRTEE-T) as a specific scale for LE, and to investigate the validity of this version by correlating and comparing its outcomes with those of the scales DASH (the Disabilities of the Arm, Shoulder, and Hand questionnaire) and Quick DASH (QDASH), pain (VAS), tenderness, and maximal grip strength (MGS). Fifty patients (14 males and 36 females) with the diagnosis of lateral epicondylitis were included in this study. PRTEE Questionnaire was translated into Turkish according to the guideline for the cross-cultural adaptation process. All patients filled the PRTEE-T questionnaire. Maximal grip strength, pain, and tenderness were measured. Next, the patients filled the DASH forms. The patients were asked to reevaluate PRTEE-T 2 h after they filled the first form. The internal consistency reliability of PRTEE-T was assessed by calculating 'if item deleted' using Cronbach alpha and 'Item–total correction' coefficient for each item of the questionnaire. Consistency of subscales was assessed using Spearman's rho correlation coefficient. In addition to correlation analysis, test–retest values were compared using Wilcoxon test to assess the changes on the basis of the items. Criterion validity of the scale was measured using DASH and QDASH scales, and construct validity was measured using tenderness and maximal grip strength values by Spearman's rho correlation coefficient. For internal reliability; Cronbach alpha coefficient was calculated 0.837 by the overall assessment of the scale. For test–retest reliability; correlation coefficient was found 0.920 ($P < 0.001$). Comparison of the scores obtained from test–retest measurements showed no significant difference ($P > 0.05$). The pain sub-scale, the function sub-scales, and the overall score from the PRTEE-T each showed significant correlations with the DASH score ($P < 0.001$), QDASH score ($P < 0.001$), and maximal grip strength ($P < 0.001$). Significant correlation was found between the sub-scales of the scale. The results of our study have shown that the Turkish version of a specific and practical scale developed for LE can be both valid and reliable. PRTEE-T is easy to apply in a relatively short period and may prove to be valuable for evaluation and follow up of the patients in daily clinical practice.

Keywords Lateral epicondylitis · PRTEE Questionnaire

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Introduction

Lateral epicondylitis (LE), or tennis elbow, is a frequently encountered clinical entity characterized by pain in the region of lateral epicondyle of humerus which is aggravated during resisted dorsiflexion of the wrist [1]. LE has been reported to have an estimated annual incidence of 1–3% in the general population and to lead to substantial loss of labor force due to the pain experienced by the patients [2].

Several treatment methods have been suggested for LE. Orthotic devices, antiinflammatory drugs, corticosteroid injections, and physical therapy modalities such as exercise,

massage, laser, electrotherapy, and ultrasound are among the treatment options for treatment of LE [3–6]. However, assessment and comparison of the above treatment methods in LE has been considered to be a difficult task by several authors mostly due to employment of nonspecific measurement methods such as maximal grip strength, pain free grip strength, indexes of tenderness, and pain evaluation according to VAS [7–9]. On the other hand, Roles & Moudsley scoring, which was developed as a specific evaluation for LE, suggests rather rough categorization of response to treatment as excellent, good, fair, and poor and lacks detailed information as to functional evaluation [10].

Overend et al. [11] assessed the outcome of treatment of LE using the patient-rated forearm evaluation questionnaire (PRFEQ). The questionnaire is based on the model of the patient-rated wrist evaluation [12]. This questionnaire has later been updated and named patient-rated tennis elbow evaluation (PRTEE) by the same study group [13].

Whenever a scale is presented to the literature, the proponents are expected to have done the reliability and validity studies, and the researchers who employ that scale are likewise expected to inquire if such studies have been done. If there are significant differences between the basic parameters of the societies for which the particular scale has been developed and for which it is planned to be employed, reliability and validity of the scale should be reassessed [14].

The original English origin of PRTEE has been found to be a reliable, reproducible, and sensitive instrument according to reliability and validity studies [11, 15, 16]. The scale has also been found to be adaptable in Hong Kong-Chinese and Swedish reliability and validity studies [17, 18].

We have not come across any Turkish scale for evaluation of follow-up of LE patients in our literature screening. We believe that translation of PRTEE to Turkish may serve as a basis for both daily practice and scientific studies done for LE patients allowing cross-cultural and international comparisons.

The proposed method for statistical analysis of the validity of a scale is application of previously developed gold standard scale and the particular scale in question to the same population. The most common method which has been regarded as comparable to PRTEE is DASH (the Disabilities of the Arm, Shoulder, and Hand questionnaire), which was first reported in 1996 for evaluation of the people with musculoskeletal upper-limb disorders [19]. DASH has been proven to be a useful self-report and The Quick DASH (QDASH), a shortened version of the DASH Outcome Measure has later been developed. The QDASH contains 11 items instead of 30 in DASH outcome measure to evaluate physical function and symptoms in people with any musculoskeletal disorder of the upper-limb [20]. Turkish versions of both DASH and QDASH have been found to be reliable and valid according to the study done by Düger et al. [21].

The purpose of our study was to test the reliability of the Turkish version of PRTEE (PRTEE-T) as a specific scale for LE, and to investigate the validity of this version by correlating and comparing its outcomes with those of the scales DASH and QDASH, pain (VAS), tenderness, and maximal grip strength.

Patients and method

Patients

Fifty patients (14 males and 36 females) with an age range of 34–60 (average: 47.52 ± 9.36 mean $\pm$ SD), who were admitted to our clinic between January 2008 and May 2008 with the diagnosis of LE, were included in the study. Our criteria for making diagnosis of LE were the complaint of pain on the lateral side of the elbow and aggravation of the pain with both resisted dorsiflexion of the wrist and pressure applied on the lateral epicondyle of the humerus. The patients who had elbow arthritis, radiculopathy, or difficulty in complying with the questionnaire were excluded from the study. The patients were instructed to refrain from anti-inflammatory medication starting 2 days before the questionnaire was given.

Cross-cultural adaptation

Permission was obtained from Dr JC MacDermid, who developed the scale. Beaton's guideline for the cross cultural adaptation process was used as the prime source for the study [22]. PRTEE Questionnaire was translated into Turkish separately by two Turkish physicians (one physiatrist, one hand surgeon) who are fluent in English. They afterwards met to resolve any discrepancy between the translations. After that English back-translations from Turkish were done separately by two non-physician people (one of them speaking English as mother language) who were totally unaware of the original English version. Then the latter pair discussed and finalized the translations. This resultant version was compared with the original English version, and was confirmed to be identical semantically. The final Turkish version (PRTEE-T) was finalized and presented to the patients.

Measurements

All patients filled the PRTEE-T questionnaire. The PRTEE-T estimates the patient's pain and function over the past week. The questionnaire consists of 15 questions: The first

five questions concern the pain in the elbow/elbows and the remaining 10 questions concentrate on function of the elbow. The part on the function includes six questions on specific activities, four questions for daily activities. The PRTEE-T allows patients to rate their level of tennis elbow pain and disability from 0 to 10. Pain Score = Sum of the 5 pain items, Function Score = Sum of the 10 function items divided by 2. Total Score is calculated as the sum of the pain and function scores.

Maximal grip strength (MGS), pain, and tenderness were measured. MGS was measured using Jamar hand dynamometer (JA Preston Corp, Jackson, United States) by instructing the patients to squeeze the dynamometer with the shoulder in 90° extension and the elbow in full extension. The strength measurement was repeated three times and average values were recorded.

Tenderness was measured using a standard pressure algometry (Force Dial FDK 60). Algometer was applied to the lateral epicondyle 3 times and the algometer score was calculated as the average of the minimum pain-generating pressure values.

Next, the patients filled the DASH forms. The patients were requested to score from 1 to 5 points any difficulty experienced during 30 different daily activities related to the upper extremity. All patients responded to all items in the questionnaire. DASH disability/symptom score was calculated as the Formula [(sum of n responses) $-$ 1] $\times$ 25/n. QDASH scale was completed by picking the relevant items from the DASH form. QDASH scores were calculated using above formula. The patients were asked to reevaluate PRTEE-T 2 h after they filled the first form. They did not have access to the first forms they filled.

Statistical method

Data were analyzed using the SPSS V.16. The probability cut-off level for significance was set at $P < 0.05$.

The internal consistency reliability of PRTEE-T was assessed by calculating 'if item deleted' using Cronbach alpha and 'Item–total correction' coefficient for each item of the questionnaire (Tables 1, 2).

Consistency of subscales was assessed using Spearman's rho correlation coefficient. Spearman's rho correlation coefficient was done to see the correlation of test–retest

Table 1 Internal consistency reliability of PRTEE-T for individual items

Item number	Item–Total correlation	Cronbach's Alpha if item deleted	Cronbach alpha
1	0.269	0.838	0.837
2	0.549	0.826	
3	0.672	0.823	
4	0.411	0.830	
5	0.713	0.823	
6	0.271	0.838	
7	0.376	0.832	
8	0.415	0.836	
9	0.519	0.824	
10	0.635	0.815	
11	0.464	0.828	
12	0.489	0.826	
13	0.600	0.820	
14	0.695	0.812	
15	0.302	0.839	

Table 2 Internal consistency reliability of PRTEE-T for subscales

PRTEE-T	Question number	Item–Total correlation	Cronbach's Alpha if item deleted	Cronbach alpha
Pain	1	0.494	0.694	0.733
	2	0.461	0.699	
	3	0.459	0.703	
	4	0.628	0.630	
	5	0.506	0.692	
Function (specific activities)	6	0.392	0.688	0.712
	7	0.496	0.674	
	8	0.467	0.675	
	9	0.491	0.659	
	10	0.406	0.686	
	11	0.502	0.655	
Function (usual activities)	12	0.484	0.742	0.755
	13	0.622	0.677	
	14	0.722	0.602	
	15	0.442	0.763	

values. In addition to correlation analysis, test–retest values were compared using Wilcoxon test to assess the changes on the basis of the items.

Criterion validity of the scale was measured using DASH and QDASH scales, and construct validity was measured using tenderness and maximal grip strength values by Spearman's rho correlation coefficient.

The reliability levels of the scale were described as follows: $r \leq 0.40$: not reliable; 0.41–0.60: low reliability; 0.61–0.80: reliable; 0.81–1.00: highly reliable [23].

Results

Internal reliability

Internal consistency of PRTEE-T for individual items and subscales is shown separately in Tables 1 and 2. Cronbach alpha coefficient was calculated 0.837 by the overall assessment of the scale. Analysis of the subgroups gave Cronbach alpha coefficient values of 0.733, 0.712, and 0.755 for pain, specific activities, and usual activities, respectively. The Item–Total correlation was found to be greater than 0.25.

Test–retest reliability

Tables 3 and 4 show the test–retest reliability for all individual items and for sub-scales. Correlation coefficients were found to be as high as 0.922 for pain; 0.906 for specific activities, 0.907 for usual activities and overall 0.920 ($P < 0.001$).

Comparison of the scores obtained from test–retest measurements showed no significant difference ($P > 0.05$).

Criterion/construct validity

The pain sub-scale, the function sub-scales, and the overall score from the PRTEE-T each showed significant correlations with the DASH score ($P < 0.001$), QDASH score ($P < 0.001$), and maximal grip strength ($P < 0.001$), as shown in Table 5.

Correlation with tenderness was significant for pain, usual activities and overall evaluation but not for the specific activities.

Table 3 The test–retest reliability for all the individual items

Item number	Test median (minimum–maximum)	Retest median (minimum–maximum)	*P* value
1	3 (0–6)	3 (0–6)	0.248
2	8 (5–9)	8 (5–9)	0.052
3	8 (7–10)	8 (7–10)	0.564
4	3 (0–6)	3 (0–6)	0.429
5	9 (7–10)	9 (7–10)	0.317
6	6 (4–9)	6 (3–9)	0.463
7	8 (5–9)	8 (4–9)	0.713
8	6 (0–9)	6 (3–9)	0.905
9	8 (3–9)	8 (4–9)	0.902
10	4 (0–7)	4 (0–7)	0.957
11	8 (3–10)	8 (3–10)	0.851
12	5 (0–8)	5 (0–8)	0.637
13	8 (4–9)	8 (4–9)	0.366
14	8 (2–10)	8 (3–10)	0.317
15	2 (0–5)	5 (3–9)	0.071

Table 4 The test–retest reliability for the subscales

	r	*P*
Pain	0.922	<0.001
Function (specific activities)	0.906	<0.001
Function (usual activities)	0.907	<0.001
Overall	0.920	<0.001

The correlation of the subgroups of the PRTEE-T

Significant correlation was found between the sub-scales of the scale (Table 6).

Discussion

The growing number of multinational and multicultural research projects has created the need for translation and adaptation of health status measure to several languages other than the source language. However, it is a well known fact that such cross-cultural adaptations of a particular

Table 5 Criterion validity of PRTEE-T against DASH, Quick DASH, tenderness and the maximal grip strength

PRTEE-T	Pain		Function (specific activities)		Function (usual activities)		Overall	
	r	*P*	*r*	*P*	*r*	*P*	*r*	*P*
DASH	0.501	0.000	0.622	0.000	0.568	0.000	0.676	0.000
Quick DASH	0.403	0.004	0.523	0.000	0.554	0.000	0.589	0.000
Tenderness	−0.411	0.003	−0.204	0.155	−0.423	0.002	−0.441	0.001
Maximal grip strength	−0.356	0.011	−0.366	0.009	−0.352	0.012	−0.427	0.002

Table 6 Correlation between the subscales of PRTEE-T

	r	*P*
Pain-function (specific activities)	0.507	<0.001
Pain-function (usual activities)	0.379	<0.01
Function (specific activities − usual activities)	0.714	<0.001

health status questionnaire necessitate development of a reliable method rather than a simple translation of the original text in order to provide equivalence between the original source and target versions.

The results of our study have shown that the Turkish version of PRTEE is a reliable and valid measurement instrument for the evaluation of patients with LE.

A scale must be shown to be reliable by statistical analysis before it is used as a method in evaluation and follow-up of patients. A reliability analysis must be based on the examination of the reliability coefficients which are suitable in obtaining the reliability of the scale and the structure of the empirical study.

In our study, we tested the reliability of our scale by using Cronbach alpha coefficient. This alpha coefficient developed by Cronbach is accepted as a valid internal consistency estimation method when the items are scored within a numerical range (such as between 1 and 10, as was done in our study) rather than as true or false.

The reliability of a scale can be examined by applying the scale once, twice (test–retest), or applying each equivalent scale once. In the case of applying a scale once, the reliability of internal consistency is examined and the reliability coefficient ranges between 0 and 1.

In our study, Cronbach alpha coefficient for internal consistency was found 0.837 for evaluation of the whole scale. This value is relatively high and shows the high internal reliability of the Turkish version of the scale and it is comparable with the coefficient value of the original article.

Test–retest method is described as application of a measurement method to the same subject group under identical conditions twice during a time interval which is long enough to prevent a significant level of recall but short enough to prevent significant variations [14, 15].

Measurement values correlation coefficient obtained from these two applications comprise the reliability coefficient of the scale. The time interval we gave to our patients for evaluation of the scale was 2 h. We decided that this is an optimal time interval because a longer interval could have led to changes in the symptoms of the patients whereas a shorter interval could allow the patients to recall the answers given to the questions of the first scale clearly. Significant test–retest correlation coefficients obtained from our study were as high as 0.92 for pain, 0.91 for the specific and general activities and overall 0.92. The correlation coefficient was found overall 0.89 in the original scale reliability study. The correlation coefficient in the English scale study by Newcommer et al. [16] was found 0.96. It was 0.99 and 0.95 for the Hongkong-Chinese version and Swedish version, respectively [17, 18]. The values obtained in these more recent studies are apparently very close to our value.

While it is possible to examine the reliability of a scale using a suitable method, owing to the dependence of the reliability on the consistency of the scale, we may not be able to obtain the proper answers as to what we want to measure using that scale or learn if the items can measure our target parameters in accordance with the basic goal.

Validity of a scale must also be evaluated in order to answer the above questions. The level of validity is determined to a large extent by the expression of the variable in question. The validity level of a scale can be found by calculating its validity coefficient which is dictated by the correlation between the values obtained from the scale and the criteria defined by the goals of the scale. The higher this validity coefficient, the more confidently the scale can be interpreted as serving its goal.

Criterion Validity and Construct Validity are tested for evaluation of the scales. Criterion Validity assesses the efficiency of the scale [24].

Construct validity is used to investigate to what degree any particular measure relates to other measures in accordance with the hypothesis on the measured concepts [15].

In our study DASH and QDASH were used to evaluate criterion validity, and tenderness and maximal hand grip power to assess construct validity. Leung et al. [18] used maximal grip strength measurements performed in two different positions, Newcommer et al. [16] used pain (VAS), DASH, 36 item short form health survey, and the pain free grip strength parameters, Rompe et al. [25] used pain (VAS), DASH and Roles Maudsley scale, and upper extremity function scale, Nilsonn et al. [17] used DASH and Roles Maudsley scale in validity studies.

We preferred Turkish version of DASH and QDASH scales which were previously been shown to have reliability and validity in evaluation of the upper extremity functions. In our study, the pain sub-scale, the function sub-scales, and the overall score from the PRTEE-S each showed significant correlations with the DASH score ($r = 0.501$; $P < 0.001$), QDASH score ($r = 0.403$; $P < 0.01$), and maximal grip strength ($r = -0.356$; $P < 0.001$). The correlation coefficients were high for DASH (0.676) but showed low validity for pain (0.441) and hand grip strength (0.427). The measurements for algometric tenderness showed significant correlation between the two parameters for pain ($r = -0.411$; $P < 0.005$), daily activities ($r = -0.423$; $P < 0.005$), and overall evaluation $r = 0.441$; $P > 0.001$) but no significant correlation for specific activities ($r = -204$; $P = 0.155$). The correlation coeffi-

cients reported by Leung et al. [18] and Newcommer et al. [16] for pain free grip strength were −0.40 and −0.45, respectively, which were close to the values in our study. However, it must be noted that the correlation coefficients were low despite being statistically significant in the above studies including ours. Leung et al. [18] have emphasized that these low levels of coefficients should be interpreted as a result of the insufficiency of an anthropometric test in detecting the actual deficit in function rather than a failure of the PRTEE. The values for correlation with DASH were found by Newcomer et al. [16] and Nilsson et al. [17] as 0.72, and 0.78, respectively, which can be interpreted as in accordance with our results despite being higher. The value reported by Rompe et al. [25] for correlation with DASH (0.66) is very close to our result. Although DASH is regarded as a standard and valid scale for the upper extremity functions, it cannot be accepted as a specific method for elbow pathologies since it involves the whole arm including both the shoulder and the elbow. Thus, the absence of a specific scale for correlation prohibits the ideal evaluation of PRTEE.

In our study, we used the five stage method, which was described by Beaton et al. [22] and is known to be a well defined and easily applied cross-cultural adaptation method. If the steps are carefully followed, the cross-cultural adaptation is consistent in the content and face validity between the source and target versions of the questionnaire. Our resultant version was confirmed to be identical semantically with English version.

The results of our study have shown that the Turkish version of a specific and practical scale developed for LE can be both valid and reliable. PRTEE-T is easy to apply in a relatively short period and may prove to be valuable for evaluation and follow-up of the patients in daily clinical practice. It may also contribute to comparison and correlation between the results of both national and international scientific studies providing a consistent and standard method.

Conflict of interest statement There is no conflicts of interest affecting the authors.

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