RESEARCH ARTICLE

Translation, Cross-Cultural Adaptation, and Psychometric Validation of the Persian Version of the Patient-Rated Ulnar Nerve Evaluation (PRUNE)

Hamed Naghizadeh, MD; Hamid Arabi, MD; Omid Salkhori, MD; Mohammad Ayati Firoozabadi, MD; Seyyed Saeed Khabiri, MD; Seyyed Hadi Kalantar, MD; Elham Poorghasem, MD; Aidin Arabzadeh, MD

Research performed at Orthopedic Surgery Department, Imam Khomeini Complex Hospital, Tehran University of Medical Sciences, Tehran, Iran

Received: 8 July 2025 *Accepted: 2 November 2025*

Abstract

Objectives: The Patient-Rated Ulnar Nerve Evaluation (PRUNE) is a validated, condition-specific instrument designed to assess symptoms and functional limitations in individuals with ulnar nerve disorders. However, no Persian adaptation has been developed to date. The present study aimed to translate, culturally adapt, and evaluate the psychometric properties of the Persian version of the PRUNE among patients with Cubital Tunnel Syndrome (CuTS).

Methods: Following international guidelines, the PRUNE was translated and culturally adapted into Persian. A total of 106 patients with clinically diagnosed Cubital Tunnel Syndrome (CuTS) were enrolled in the study. Internal consistency was evaluated using Cronbach's alpha, and test–retest reliability was determined with the Intraclass Correlation Coefficient (ICC) over a two-week interval. Construct validity was examined through an exploratory factor analysis (EFA) using principal component extraction and Varimax rotation. Convergent validity was examined by assessing the correlations between PRUNE scores and those of established instruments, including the QuickDASH, DASH, and Visual Analog Scale (VAS).

Results: The Persian version of the PRUNE demonstrated excellent internal consistency (Cronbach's α = 0.889) and strong test–retest reliability (ICC = 0.886). Exploratory factor analysis confirmed a multidimensional factor structure consistent with that of the original instrument. Significant positive correlations were observed between the PRUNE and the QuickDASH (r = 0.768), DASH (r = 0.699), and VAS (r = 0.664), supporting its convergent validity.

Conclusion: The Persian version of the PRUNE proved to be a reliable and valid instrument for assessing symptoms and functional limitations in Persian-speaking patients with Cubital Tunnel Syndrome. It can be confidently applied in both clinical practice and research contexts.

Level of evidence: II

Keywords: Cross-cultural adaptation, Cubital tunnel syndrome, Persian translation, PRUNE, Psychometric validation, Upper limb assessment

Introduction

Ulnar neuropathy at the elbow, commonly known as Cubital Tunnel Syndrome (CuTS), is the second most common compressive neuropathy of the upper limb after carpal tunnel syndrome. The condition may cause pain, numbness, tingling, muscle weakness, and functional limitations of the upper extremity, particularly affecting grip strength and fine motor control. These symptoms can markedly reduce patients' quality of life and interfere with their ability to perform daily activities.[1-6]

Practical assessment of upper limb function in patients with ulnar nerve dysfunction is essential for both clinical decision-making and outcome evaluation. Several generic and region-specific questionnaires, such as the Disabilities of the Arm, Shoulder and Hand (DASH) and its shortened version, the Quick DASH, have been developed to evaluate

Corresponding Author: Aidin Arabzadeh, Joint Reconstruction Research Center, Department of Orthopedic Surgery, Tehran University of Medical Sciences, Tehran, Iran, Department of Orthopedic Surgery, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran

Email: Aidin.medico@gmail.com

THE ONLINE VERSION OF THIS ARTICLE ABJS.MUMS.AC.IR

upper limb disability. However, these instruments were not designed explicitly for ulnar nerve–related impairments and may fail to capture the full range of symptoms and functional limitations associated with Cubital Tunnel Syndrome (CuTS).[7-13]

The Patient-Rated Ulnar Nerve Evaluation (PRUNE) was specifically developed to assess pain, disability, and functional limitations in patients with ulnar neuropathy. It comprises 20 items that address symptoms, specific functional limitations, and general activities, demonstrating high sensitivity to clinical changes. The PRUNE has shown strong psychometric properties in its original English version and has been successfully validated in several other languages.[14-17]

However, no validated Persian version of the PRUNE is currently available for use among Persian-speaking populations, particularly in Iran, where CuTS is frequently encountered in orthopedic and rehabilitation settings. Considering the importance of culturally appropriate assessment tools, adapting and validating the PRUNE for Persian-speaking patients is therefore essential.

Therefore, this study aimed to translate, culturally adapt, and psychometrically validate the Persian version of the Patient-Rated Ulnar Nerve Evaluation (PRUNE) in a cohort of patients diagnosed with Cubital Tunnel Syndrome (CuTS).

Materials and Methods

Study Design

This methodological study aimed to translate, culturally adapt, and evaluate the psychometric properties of the Patient-Rated Ulnar Nerve Evaluation (PRUNE) questionnaire into Persian. The process was carried out in several phases following established guidelines for the cross-cultural adaptation of self-report instruments [Figure 1].[14,18-122]

ارزیابی عصب اولنار بر اساس نظر بیمار

تاریخ ارزیابی : نام بیمار :

سوالات زیر به ما کمک می‌کنند تا میزان درد یا دشواری‌ای که به خاطر دست/بازوی خود تجربه می‌کنید را بهتر درک کنیم. لطفاً متوسط چیزی را که در طی هفته گذشته تجربه کرده اید توصیف نمایید.

شدت درد خود را ارزیابی کنید	10 = بیشترین میزان درد 0 = بدون درد										
وقتی که در بدترین حالت خود قرار دارد	0	1	2	3	4	5	6	7	8	9	10
در زمان استراحت	0	1	2	3	4	5	6	7	8	9	10
صبح ها	0	1	2	3	4	5	6	7	8	9	10
بعد از کار یا فعالیت	0	1	2	3	4	5	6	7	8	9	10
شبها (هنگام خواب)	0	1	2	3	4	5	6	7	8	9	10
0 هرگز هر چند وقت یکبار درد دارید؟	1	2	3	4	5	6	7	8	9	10 همیشه	

شدت سایر علائم خود را ارزیابی کنید	10 = بد ترین حالت ممکن 0 = بدون مشکل										
بی‌حسی در انگشت کوچک (پنجم) دست	0	1	2	3	4	5	6	7	8	9	10
احساس سوزن‌سوزن شدن در انگشت کوچک (پنجم) دست	0	1	2	3	4	5	6	7	8	9	10
ناتوانی در کنترل موقعیت یا حرکت انگشت کوچک (پنجم) دست	0	1	2	3	4	5	6	7	8	9	10
ضعف در دست من(نیشگون گرفتن و مشت کردن)	0	1	2	3	4	5	6	7	8	9	10

شدت سختی انجام فعالیت‌های زیر را ارزیابی کنید:	10 = کاملا ناتوان در انجام آن‌ها 0 = بدون مشکل										
غذا خوردن (استفاده از قاشق ،چنگال و یا چاقو)	0	1	2	3	4	5	6	7	8	9	10
بلند کردن یک جسم سنگین	0	1	2	3	4	5	6	7	8	9	10
نگه داشتن یک شیء (مثل ابزار، کتاب، تلفن یا وسیله الکترونیکی) به مدت یک ساعت	0	1	2	3	4	5	6	7	8	9	10
دست دراز کردن و برداشتن وسایل به‌طور مکرر	0	1	2	3	4	5	6	7	8	9	10
کارهایی با حرکت‌های تکراری انگشت، مثل تایپ کردن، ساز زدن یا کار کردن با وسایل ریز	0	1	2	3	4	5	6	7	8	9	10
چرخاندن کلید یا باز کردن در با دستگیره	0	1	2	3	4	5	6	7	8	9	10

فعالیت‌های روزمره – میزان سختی انجام فعالیت‌های معمولی‌ای که پیش از شروع مشکل دست یا بازویتان انجام می‌دادید را ارزیابی کنی:

	10 = کاملا ناتوان در انجام آن 0 = بدون مشکل										
امور مربوط به نظافت شخصی (مثل استحمام، لباس پوشیدن)	0	1	2	3	4	5	6	7	8	9	10
کارهای خانه (مثل نظافت و رسیدگی به امور منزل)	0	1	2	3	4	5	6	7	8	9	10
کار – شامل شغل یا فعالیت‌های روزمره‌ی شما	0	1	2	3	4	5	6	7	8	9	10
کارهای تفریحی و سرگرمی	0	1	2	3	4	5	6	7	8	9	10

Figure 1. The Persian version of the Patient-Rated Ulnar Nerve Evaluation (PRUNE) questionnaire

Study Population

A total of 106 patients diagnosed with Cubital Tunnel Syndrome (CuTS) were recruited from our institution's outpatient orthopedic clinic between 2023 and 2025. All participants were non-surgical at the time of enrollment and had not yet undergone any operative interventions. The severity of CuTS was classified according to McGowan's three-stage clinical grading system, which categorizes patients as mild (sensory symptoms only), moderate (sensory symptoms with mild motor weakness), or severe (marked motor weakness or atrophy).[23,24]

The sample size was determined in accordance with widely accepted psychometric guidelines, which recommend recruiting 5-10 participants per questionnaire item to ensure sufficient statistical power for factor analysis and reliability assessment.[25-27]

Inclusion criteria were as follows: adults aged 18 years or older with a clinical diagnosis of Cubital Tunnel Syndrome (CuTS) confirmed by a specialist, and sufficient ability to understand and complete the Persian version of the PRUNE questionnaire.

Exclusion criteria comprised patients with a history of upper limb surgery, comorbid neurological or musculoskeletal disorders affecting the upper extremity, or any cognitive or psychiatric impairments that could interfere with self-reporting.

The final sample was considered adequate to support a robust psychometric analysis and to ensure the external validity of the findings for the Persian-speaking population with Cubital Tunnel Syndrome (CuTS).[25,28]

Translation

Two independent, bilingual experts with orthopedic experience translated the PRUNE into Persian. A multidisciplinary committee consisting of the translators, orthopedic specialists, and a statistician reviewed both translations and synthesized them into a single preliminary version.

Back-Translation

To ensure translation accuracy, the Persian version was back-translated into English by an independent bilingual expert who was blinded to the study objectives. Any discrepancies between the back-translated and original English versions were reviewed and resolved to further refine the Persian adaptation.

Expert Review and Finalization

A panel comprising four orthopedic specialists, one statistician, and two translators conducted a comprehensive review to finalize the Persian version of the PRUNE.

Outcome Measures

The Patient-Rated Ulnar Nerve Evaluation (PRUNE) questionnaire was used to assess upper-extremity function and symptom severity in patients with Cubital Tunnel Syndrome (CuTS). The PRUNE is a disease-specific, self-administered instrument developed to evaluate symptoms and functional disability associated with ulnar nerve compression.

The PRUNE consists of 20 items grouped into four domains: pain, sensory/motor symptoms, specific functional activities, and usual activities. Each item is rated on an 11-point numerical scale ranging from 0 to 10, where 0 denotes no problem and 10 indicates the worst possible severity or disability. The total score ranges from 0 to 100, with higher scores indicating greater impairment.[14]

To ensure consistency in questionnaire administration, participants received standardized written and verbal instructions. For illiterate participants or those with reading difficulties, a trained researcher read the items aloud without providing any interpretation or additional explanation.

Reliability Testing

To assess the instrument's temporal stability, the finalized Persian version of the PRUNE was administered twice to 106 patients with Cubital Tunnel Syndrome (CuTS) with a 2-week interval between administrations.

Test–retest reliability was evaluated using the Intraclass Correlation Coefficient (ICC) based on a two-way random-effects model (consistency type), with 95% confidence intervals (CI) calculated for all estimates.[29]

ICC values between 0.70 and 0.85 were interpreted as indicating good reliability, whereas values exceeding 0.85 were considered to represent excellent reliability, in accordance with established psychometric standards.[29]

The test–retest interval was set at two weeks, consistent with prior cross-cultural validation studies of similar instruments. Previous research has shown that a two-week interval is generally sufficient to minimize recall bias while maintaining temporal stability in assessing measurement consistency.

Although the PRUNE primarily evaluates functional and symptom-based outcomes, it is recognized that symptom perception in peripheral nerve disorders may fluctuate slightly over short periods. Nevertheless, this two-week interval is widely accepted in psychometric research and was considered appropriate to balance participant burden with the requirement for adequate temporal separation in reliability assessment.[25,30]

Internal consistency, defined as the degree to which items within a scale measure the same underlying construct, was evaluated using Cronbach's alpha (α) and item–total correlations. Cronbach's alpha values greater than 0.90 were interpreted as excellent, indicating strong unidimensionality of the instrument, although values exceeding 0.95 may suggest redundancy among items. Values between 0.80 and 0.89 were considered good, whereas values from 0.70 to 0.79 were regarded as acceptable.[31]

Additionally, item–total correlations were computed to evaluate the degree to which each item correlated with the overall scale score, excluding the item under analysis from the total. A minimum item–total correlation coefficient of 0.40 was considered the acceptable threshold, indicating that each item contributed adequately to the overall measurement of the underlying construct.[32]

Validation:Content Validity

Owing to the absence of a validated Persian instrument for

assessing wound quality, content validity was evaluated using the Content Validity Ratio (CVR) and the Content Validity Index (CVI). Fourteen experts rated the necessity of each item using Lawshe's method, with a CVR cutoff of 0.51. In addition, each item was evaluated for relevance on a four-point scale, and a CVI threshold of 0.79 was considered acceptable.[33,34]

Construct Validity

To examine the construct validity of the Persian version of the PRUNE, an Exploratory Factor Analysis (EFA) was performed using Principal Component Analysis (PCA) with Varimax rotation. This approach was employed to identify the underlying factor structure of the translated instrument and to determine whether the items clustered in a conceptually coherent manner.[35]

The Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity were employed to evaluate the adequacy of the data for factor analysis. Although the subject-to-item ratio (5.3:1) was at the lower end of the recommended guideline, it still met widely accepted criteria for EFA suitability, indicating a minimum of 5 participants per item.[26,27] A KMO value exceeding 0.60 and a significant Bartlett's test result ($p < 0.05$) were considered indicative of sampling adequacy and sufficient inter-item correlations. Factors were extracted based on eigenvalues> 1.0 and a visual inspection of the scree plot; items with factor loadings ≥ 0.40 were considered to load significantly on a factor.[36]

In addition to factor analysis, convergent validity was assessed by examining correlations between the Persian version of the PRUNE and three established measures of upper limb disability: the QuickDASH, DASH, and Visual Analog Scale (VAS) for pain.[7,8,37] Total scores for the PRUNE and each comparator instrument were computed, and Pearson's correlation coefficients were used to determine the strength and direction of the associations.

Ceiling and floor effects were assessed by calculating the proportion of participants who achieved the lowest (0) and highest (100) possible scores. According to established psychometric criteria, values below 15% were considered acceptable, indicating the absence of ceiling or floor effects.[29]

Results

A total of 106 participants were included in the study, with a mean age of 48.6 ± 9.31 years. The majority were female (58.5%), and most had a university-level education (58.5%). According to McGowan's classification, 53.8% of patients were grade 2, followed by grade 3 (35.8%) and grade 1 (10.4%). Common comorbidities included diabetes mellitus (24.5%), hypertension (17.9%), hypothyroidism (14.2%), and rheumatoid disease (6.6%) [Table 1].

Table 1. Patient demographic information

Characteristic		N (%)
Age in years, (mean ±SD)		48.60 ± 9.31
Age in years, range		23 - 65
Gender		
Male		44 (41.5%)
Female		62 (58.49%)
Total		**N=106**
McGowan grade	*Grade 1*	11(10.37%)
	Grade 2	57(53.77%)
	Grade 3	38(35.84%)
Weight in kg, (mean±SD)		76.3± 12.3
Height in cm, (mean±SD)		159 ± 9.3
Educational level		
Primary school		13 (12.26%)
High school		31 (29.24%)
University degree		62 (58.49%)
Comorbidities		
Hypertension		19 (17.92%)
Diabetes mellitus		26 (24.52%)
Hypothyroidism		15 (14.15%)
Rheumatoid disease		7 (6.6%)

Reliability

The overall Cronbach's alpha coefficient for the questionnaire was 0.889, indicating high internal consistency. Item-deleted Cronbach's alpha values ranged from 0.876 to 0.888, suggesting that all items contributed meaningfully to the total scale [Table 2].

Test–retest reliability was examined over a two-week interval in 106 participants. The Intraclass Correlation Coefficient (ICC) was computed using a two-way random-effects model with absolute agreement. The ICC for the total PRUNE score was 0.886 (95% CI: 0.841–0.921), demonstrating excellent test–retest reliability. Although the overall Cronbach's alpha for the Persian PRUNE was high (0.889), item–total correlation coefficients for Q6 (0.343), Q9 (0.368), Q10 (0.372), Q14 (0.343), and Q20 (0.360) were below the 0.40 threshold, indicating that these items contributed less strongly to the overall construct [Table 2].

Table 2. Reliability Analysis of Individual Items: Internal Consistency and Test–Retest Stability (Cronbach's Alpha and ICC with 95% CI)

PRUNE	Item	Cronbach's Alpha	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	ICC Test–retest (95%CI)
Pain	*Q1*	0.889	0.572	0.883	0.78(0.66-0.86)
	Q2		0.588	0.882	0.71(0.57-0.81)
	Q3		0.752	0.876	0.89(0.83-0.93)
	Q4		0.599	0.881	0.91(0.87-0.95)
	Q5		0.516	0.883	0.85(0.76-0.90)
	Q6		0.343	0.888	0.80(0.69-0.87)
Sensory/motor symptoms	*Q7*		0.416	0.887	0.89(0.82-0.93)
	Q8		0.533	0.883	0.74(0.61-0.83)
	Q9		0.368	0.888	0.70(0.55-0.80)
	Q10		0.372	0.888	0.74(0.60-0.83)
Specific activity	*Q11*		0.466	0.885	0.75(0.62-0.84)
	Q12		0.492	0.885	0.83(0.73-0.89)
	Q13		0.608	0.88	0.82(0.74-0.90)
	Q14		0.343	0.888	0.82(0.72-0.88)
	Q15		0.494	0.884	0.77(0.65-0.85)
	Q16		0.531	0.883	0.79(0.69-0.87)
Usual activity	*Q17*		0.516	0.883	0.84(0.76-0.90)
	Q18		0.722	0.880	0.77(0.65-0.85)
	Q19		0.602	0.881	0.82(0.72-0.88)
	Q20		0.36	0.888	0.71(0.57-0.81)

Content Validity

The content validity of the Persian PRUNE was evaluated using the Content Validity Ratio (CVR) and Content Validity Index (CVI) across all 20 items. According to Lawshe's criteria for 14 experts, the minimum acceptable CVR value was 0.51. All items exceeded this threshold, with CVR values ranging from 0.57 to 1.00. The CVI scores ranged from 0.85 to 1.00, indicating high levels of item relevance, clarity, and appropriateness. These results confirm that the translated items are conceptually sound and culturally appropriate [Table 3].

Table 3. Rotated Component Matrix of the PRUNE Questionnaire

Item	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6
Q1	---	---	---	---	---	-0.754
Q2	---	---	0.762	---	---	0.305
Q3	---	0.791	---	---	---	---
Q4	0.804	---	---	---	---	---
Q6	0.481	---	0.441	---	0.359	---
Q7	0.378	0.634	---	---	---	---
Q8	0.733	0.417	---	---	---	---
Q9	---	---	---	---	0.497	---

Table 3. Continued						
Q10	0.438	0.738	---	---	---	---
Q11	---	0.735	---	---	---	---
Q12	0.730	---	---	---	---	---
Q13	0.740	---	0.372	---	---	---
Q14	0.821	---	---	---	---	---
Q15	0.845	---	---	---	---	---
Q16	---	---	0.792	---	---	---
Q17	---	---	---	---	0.467	0.622
Q18	---	---	---	0.812	---	---
Q19	---	---	0.339	0.333	-0.657	---
Q20	---	---	---	0.796	---	---

Construct Validity

Exploratory Factor Analysis (EFA) was performed to assess the structural validity of the Persian PRUNE. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.744, indicating satisfactory sample adequacy. Bartlett's test of sphericity was significant ($\chi^2(171) = 1035.52$, $p < 0.001$), confirming that the data were suitable for factor analysis.

Principal Component Analysis with Varimax rotation extracted six components with eigenvalues greater than 1.0. Items were considered to load significantly on a factor if their loadings were ≥ 0.40. The rotated component matrix showed that the items were meaningfully distributed across the six factors, confirming PRUNE's multidimensional structure [Table 3].

Convergent validity was examined by calculating Pearson's correlation coefficients between the Persian PRUNE and other validated instruments, including the QuickDASH, DASH, and Visual Analog Scale (VAS) for pain. The PRUNE demonstrated a strong correlation with the QuickDASH ($r = 0.768$, $p < 0.001$), a moderate-to-strong correlation with the DASH ($r = 0.699$, $p < 0.001$), and a moderate correlation with the VAS ($r = 0.664$, $p < 0.001$), indicating that the PRUNE effectively measures constructs related to upper limb function and pain [Table 4]. No ceiling or floor effects were observed, as no participant achieved either the minimum (0) or maximum (100) total score on the Persian PRUNE.

Table 4. Content Validity and Convergent Construct Validity of the Persian PRUNE

PRUNE	Item	CVR	CVI
Pain	Q1	0.85	0.92
	Q2	0.57	0.85
	Q3	0.57	0.85
	Q4	0.71	0.92
	Q5	0.85	1
	Q6	0.85	1
Sensory/motor symptoms	Q7	1	1
	Q8	1	0.92
	Q9	0.85	0.85
	Q10	0.85	0.85
Specific activity	Q11	0.85	0.92
	Q12	0.57	0.85
	Q13	0.57	0.85
	Q14	0.71	0.85
	Q15	0.85	0.85
	Q16	0.71	0.92

Table 4. Continued			
Usual activity	Q17	0.85	0.92
	Q18	0.85	0.92
	Q19	1	1
	Q20	0.85	1
Instrument	Construct Validity: Correlation Results		
	Pearson r	Pearson p-value	
DASH	0.699	< 0.001	
Quick DASH	0.768	< 0.001	
VAS	0.664	< 0.001	

Discussion

This study aimed to translate, culturally adapt, and validate the Persian version of the Patient-Rated Ulnar Nerve Evaluation (PRUNE) for patients with Cubital Tunnel Syndrome (CuTS). The results demonstrate that the Persian PRUNE possesses excellent psychometric properties, supporting its use as a valid and reliable patient-reported outcome measure in both clinical practice and research.

To date, only two translated versions of the PRUNE—in Polish and Turkish—have been published, both demonstrating good reliability and construct validity.[16,17] Our findings are consistent with these previous validations. For example, similar to the Polish version reported by Koziej et al. (Cronbach's α = 0.93, ICC = 0.92), the Persian PRUNE exhibited strong internal consistency and excellent test–retest reliability.[17]

Although the internal consistency of the Persian PRUNE was strong, several items demonstrated item–total correlations slightly below the recommended 0.40 threshold. These items (Q6, Q9, Q10, Q14, and Q20) may capture aspects of ulnar neuropathy that Persian-speaking patients perceive differently, such as subtle sensory or functional experiences. This finding highlights the importance of accounting for cultural and linguistic context in questionnaire validation. Nevertheless, the high Cronbach's alpha and ICC values support the instrument's overall reliability.

In the present study, exploratory factor analysis identified six components with eigenvalues greater than 1.0, confirming the multidimensional structure of the Persian PRUNE. While the original English version of the instrument was conceptualized with four domains—pain, sensory/motor symptoms, specific functional activities, and usual activities—the emergence of six components in the Persian version suggests a potentially different organization of symptom and activity patterns within this cultural context.[14,16,17]

This six-factor solution may reflect subtle distinctions perceived by Persian-speaking patients, such as a clearer separation between functional limitations in specific versus routine daily tasks, or differentiation between sensory symptoms and pain-related experiences. Although this structure differs from the four-domain model originally proposed by MacDermid and Grewal, it underscores the role of cultural and contextual factors in shaping patients' perceptions and symptom reports. Future research should further investigate the stability of this six-factor structure across larger, more diverse samples and explore its potential implications for clinical assessment and treatment planning.[14,16,17]

Moreover, convergent validity was examined using the DASH, QuickDASH, and VAS scores. The moderate-to-strong correlations observed between these instruments and the PRUNE support the theoretical association between ulnar neuropathy–related impairments and upper limb disability. These findings are consistent with previous studies, further reinforcing the value of the PRUNE as a comprehensive, disease-specific assessment instrument.[7,8,15,37]

During the translation and cultural adaptation process, several semantic and contextual challenges emerged that required careful modification to ensure cultural relevance and clarity for Persian-speaking patients. For example, the term "chopsticks" appeared in an item assessing fine motor skills during eating. Since chopsticks are not commonly used in Iranian culture, the item was modified to reflect culturally appropriate utensils, rendered as "spoon and fork" in Persian, while preserving the original concept. Similarly, the phrase "repeated reaching" posed translation challenges due to its abstract nature and the lack of a straightforward Persian equivalent. This item was rephrased as "repeatedly extending the hand/arm", which conveyed the intended repetitive upper limb movement in a functionally relevant context. These adaptations were essential for maintaining content validity and ensuring patient comprehension and engagement during questionnaire completion.

One of the key strengths of this study is the rigorous methodological process employed for translation and validation, which adhered closely to established international guidelines.[18,20-22,28,30] In addition, the inclusion of a relatively large and diverse sample of 106 patients enhanced the generalizability of the findings.

Nevertheless, several limitations should be acknowledged. First, although the sample size met psychometric requirements, it was limited to preoperative patients

recruited from a single center. Future research should assess the responsiveness of the Persian PRUNE to clinical interventions and its applicability in longitudinal designs. Furthermore, while the correlation analyses supported convergent validity, known-group and discriminant validity were not explored in depth.

Overall, the Persian PRUNE is a robust, reliable, and valid instrument for assessing pain, sensory/motor symptoms, and functional disability in Persian-speaking patients with Cubital Tunnel Syndrome (CuTS). Its application can enhance clinical evaluation, facilitate treatment monitoring, and promote standardized outcome reporting in both clinical and research contexts.

Conclusion

The Persian version of the PRUNE demonstrated excellent reliability and validity, confirming its multidimensional structure and clinical relevance. Significant correlations with the DASH, QuickDASH, and VAS provided support for its convergent validity. The cultural adaptation process ensured clarity, comprehensibility, and cultural appropriateness for Persian-speaking patients. Overall, the Persian PRUNE is a valid, reliable, and practical instrument for assessing symptoms and functional impairment in individuals with Cubital Tunnel Syndrome, suitable for use in both clinical practice and research settings.

Acknowledgement

The authors would like to thank Dr. Joy MacDermid for granting permission to translate and adapt the PRUNE questionnaire into Persian and for sharing valuable resources to support the process.

Authors Contribution: Authors who conceived and designed the analysis: Hamed Naghizadeh, Aidin Arabzadeh/ Authors who collected the data: Mohammad Ayati Firoozabadi, Omid Salkhori/ Authors who contributed data or analysis tools: Seyyed Saeed Khabiri, Hamid Arabi, Elham poorghasem/ Authors who performed the analysis: Hamed Naghizadeh, Seyyed hadi kalantar/ Authors who wrote the paper: Hamed Naghizadeh

Declaration of Conflict of Interest: The authors declare that have no conflict of interest to disclose.

Declaration of Funding: The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Declaration of Ethical Approval for Study: This study has been reviewed and approved by the Ethics Committee of Tehran University of Medical Sciences with the ethical approval code IR.TUMS.IKHC.REC.1404.042.

Declaration of Informed Consent: The authors declare that there is no information that can be used to identify patients.

Hamed Naghizadeh MD [1,4]
Hamid Arabi MD [2]
Omid Salkhori MD [1,4]
Mohammad Ayati Firoozabadi MD [1,4]
Seyyed Saeed Khabiri MD [1]
Seyyed Hadi Kalantar MD [1,4]
Elham Poorghasem MD [3]
Aidin Arabzadeh MD [1,4]

1 Joint Reconstruction Research Center, Department of Orthopedic Surgery, Tehran University of Medical Sciences, Tehran, Iran

2 Orthopedic Research Center, Shahid Kamyab Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

3 Department of Pediatrics, Children's Medical Center, Tehran University of Medical Sciences, Tehran, Iran

4 Department of Orthopedic Surgery, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran

References

1. Dy CJ, Mackinnon SE. Ulnar neuropathy: evaluation and management. Curr Rev Musculoskelet Med. 2016;9(2):178-84. doi: 10.1007/s12178-016-9327-x.
2. Cambon-Binder A. Ulnar neuropathy at the elbow. Orthop Traumatol Surg Res. 2021;107(1S):102754. doi: 10.1016/j.otsr.2020.102754.
3. Bartoletti D, Gupta A, Bohne W, Gresham S, Ghayyad K, Kachooei A. Peripheral Nerve Syndromes at the Elbow: A Review of Current Treatments. Arch Bone Jt Surg. 2025.doi:10.22038/abjs.2025.87645.3996.
4. Gu AS, Bingi P, Ginder J, Flynn J, Khak M, Ilyas AM. A Systematic Review of Retrospective Evidence on Patient and Surgical Factors in Recurrent Cubital Tunnel Syndrome. Arch Bone Jt Surg. 2025;13(10):611-621. doi: 10.22038/ABJS.2025.89107.4040.
5. Arabzadeh A, Guity M, Firoozabadi MA, Salkhori O, Khabiri SS, Naghizadeh H. Comparison of two skin closure techniques in open carpal tunnel release: a randomized controlled trial on postoperative pillar pain and scar quality. Annals of Medicine and Surgery. 2025 Sep 1;87(9):5542-50.
6. Naghizadeh H, Salkhori O, Akrami S, Khabiri SS, Arabzadeh A. Diagnostic challenges of carpal tunnel syndrome in patients with congenital thenar hypoplasia: a comprehensive review. Journal of Orthopaedic Surgery and Research. 2025 May 16;20(1):473.
7. Ebrahimzadeh MH, Moradi A, Vahedi E, Kachooei AR, Birjandinejad A. Validity and reliability of the Persian version of shortened disabilities of the arm, shoulder and hand questionnaire (quick-DASH). Int J Prev Med. 2015:6:59. doi: 10.4103/2008-7802.160336. eCollection 2015.
8. Mousavi SJ, Parnianpour M, Abedi M, et al. Cultural adaptation and validation of the Persian version of the Disabilities of the

Arm, Shoulder and Hand (DASH) outcome measure. Clin Rehabil. 2008;22(8):749-57. doi: 10.1177/0269215508085821.
9. Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder and hand questionnaire (Quick DASH): validity and reliability based on responses within the full-length DASH. BMC Musculoskelet Disord. 2006:7:44. doi: 10.1186/1471-2474-7-44.
10. 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(6):602-8. doi: 10.1002/(SICI)1097-0274(199606)29:6<602::AID-AJIM4>3.0.CO;2-L.
11. Guity MR, Sahebi M, Pourfarzaneh M, Salkhori O, Ghiasi M, Bagheri N. The Efficacy of Platelet-Rich Plasma Compared to Corticosteroids for Partial-thickness Rotator Cuff Tears: A Randomized Controlled Trial. JSES International. 2025 Dec 2:101409.
12. Arabzadeh A, Salkhori O, Akrami S, Dachek A, Arabzadeh M, Naghizadeh H. Functional and electrophysiological outcomes following surgical treatment of cubitus varus associated with tardy ulnar nerve palsy: A case series. Shoulder & Elbow. 2025 Aug 21:17585732251369515.
13. Bagheri N, Naghizadeh H, Kalantar SH, Salkhori O, Khabiri SS. Surgical versus non-surgical management for minimally displaced isolated greater tuberosity in primary shoulder dislocation. Current Orthopaedic Practice. 2022 May 12:10-97.
14. MacDermid JC, Grewal R. Development and validation of the patient-rated ulnar nerve evaluation. BMC Musculoskelet Disord. 2013:14:146. doi: 10.1186/1471-2474-14-146.
15. Szekeres M, MacDermid JC, King GJ, Grewal R. The relationship between the Patient-rated Ulnar Nerve Evaluation and the common impairment measures of grip strength, pinch strength, and sensation. J Hand Ther. 2015;28(1):39-44; quiz 45. doi: 10.1016/j.jht.2014.10.003.
16. Aksoy MK, Aksoy A, Ercan İ, Altan L. Reliability and validity of the Turkish version of patient-rated ulnar nerve evaluation scale. Hand Microsurg. 2020;9(0):1-37.
17. Koziej M, Trybus M, Mydłowska A, Piątek K, Banach M, Hołda M. Polish version of the Patient-Rated Ulnar Nerve Evaluation in preoperative patients: Translation and psychometric testing. J Hand Ther. 2019;32(1):86-92. doi: 10.1016/j.jht.2017.08.004.
18. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000;25(24):3186-91. doi: 10.1097/00007632-200012150-00014.
19. Eremenco SL, Cella D, Arnold BJ. A comprehensive method for the translation and cross-cultural validation of health status questionnaires. Eval Health Prof. 2005;28(2):212-32. doi: 10.1177/0163278705275342.
20. McKown S, Acquadro C, Anfray C, et al. Good practices for the translation, cultural adaptation, and linguistic validation of clinician-reported outcome, observer-reported outcome, and performance outcome measures. J Patient Rep Outcomes. 2020;4(1):89. doi: 10.1186/s41687-020-00248-z.
21. Wild D, Grove A, Martin M, et al. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation. Value Health. 2005;8(2):94-104. doi: 10.1111/j.1524-4733.2005.04054.x.
22. Acquadro C, Patrick DL, Eremenco S, et al. Emerging good practices for translatability assessment (TA) of patient-reported outcome (PRO) measures. J Patient Rep Outcomes. 2017;2(1):8. doi: 10.1186/s41687-018-0035-8.
23. Mcgowan AJ. The results of transposition of the ulnar nerve for traumatic ulnar neuritis. J Bone Joint Surg Br. 1950;32-B(3):293-301. doi: 10.1302/0301-620X.32B3.293.
24. Arabzadeh A, Salkhori O, Akrami S, Dachek A, Arabzadeh M, Naghizadeh H. Functional and electrophysiological outcomes following surgical treatment of cubitus varus associated with tardy ulnar nerve palsy: A case series. Shoulder Elbow. 2025:17585732251369515. doi: 10.1177/17585732251369515.
25. Naghizadeh H, guity M, Ayati Firoozabadi M, Khabiri SS, Arabzadeh A. Translation, Validation, and Cross-Cultural Adaptation of the Patient and Observer Scar Assessment Scale (POSAS) into Persian. Arch Bone Jt Surg. 2025;13(10):649-655. doi: 10.22038/ABJS.2025.84746.3857.
26. MacCallum RC, Widaman KF, Zhang S, Hong S. Sample size in factor analysis. Psychological methods. 1999;4(1):84.
27. Everitt BS. Multivariate analysis: The need for data, and other problems. Br J Psychiatry. 1975:126:237-40. doi: 10.1192/bjp.126.3.237.
28. Deslauriers V, Rouleau DM, Alami G, MacDermid JC. Translation of the Patient Scar Assessment Scale (PSAS) to French with cross-cultural adaptation, reliability evaluation and validation. Can J Surg. 2009;52(6):E259-63.
29. Terwee CB, Bot SD, de Boer MR, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol. 2007;60(1):34-42. doi: 10.1016/j.jclinepi.2006.03.012.
30. Vercelli S, Ferriero G, Bravini E, et al. Cross-cultural adaptation, reproducibility and validation of the Italian version of the Patient and Observer Scar Assessment Scale (POSAS). Int Wound J. 2017;14(6):1262-1268. doi: 10.1111/iwj.12795.
31. Santos JRA. Cronbach's alpha: A tool for assessing the reliability of scales. The Journal of Extension. 1999;37(2):15.
32. McHorney CA, Ware Jr JE, Lu JR, Sherbourne CD. The MOS 36-ltem Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. Med Care. 1994;32(1):40-66. doi: 10.1097/00005650-199401000-00004.
33. Lawshe CH. A quantitative approach to content validity. Personnel psychology. 1975;28(4).
34. Waltz CF, Bausell BR. Nursing research: design statistics and computer analysis. Davis Fa; 1981.
35. Costello AB, Osborne J. Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Practical assessment, research, and evaluation. 2005;10(1).
36. Kaiser HF. An index of factorial simplicity. psychometrika. 1974;39(1):31-6.
37. Olyaei GR, Mousavi SJ, Montazeri A, Malmir K. Translation and validation study of the Persian version of the Oxford shoulder instability score. Journal of Modern Rehabilitation. 2016;10(1):24-8.