

A Prediction Model to Identify Risk of Developing Stevens-Johnson Syndrome or Toxic Epidermal Necrolysis in Patients with Erythema Multiforme⁺

LS Tham,¹MSc, PharmD, PA Tambyah,²MBBS

Introduction

Erythema multiforme (EM), Stevens-Johnson syndrome (SJS) and Toxic Epidermal Necrolysis (TEN) are part of a spectrum of muco-cutaneous syndromes^{1,2} and are often the result of drug therapies or infections. SJS and TENS have been associated with severe morbidity and mortality of up to 15%³ to 50%.⁴ The aim of this study was to determine predictors for SJS and TEN to allow early recognition of cases likely to have an adverse outcome in patients presenting with EM.

Materials and Methods

All cases presented to the National University Hospital under the International Classification of Diseases Adapted, 9th Modification (ICD-9) coding of 695.1, encompassing EM, SJS and TEN, as a primary or secondary diagnosis were captured electronically. The diagnoses for EM, SJS and TEN were confirmed based on published criteria.^{3, 4, 5}

Data extracted from the case notes included patients' demographics, symptoms on initial presentation, definite and probable causative agents, history of previous drug allergies and existing co-morbidities. A prediction model to differentiate patients with cutaneous rash at risk of developing into SJS or TEN was established based on the above factors. Data were analysed using the Statistical Package for the Social Sciences (SPSS release 10.0, SPSS Inc). Confidence intervals were set at 95%. Classification and Regression Tree (CART version 5.0, Salford Systems) analysis was used to determine the breakpoint for the continuous variable, age and to build a prediction model identifying the order of importance of risk factors for developing SJS or TEN. Significant covariates identified by univariate analysis were then applied to run a stepwise multivariate regression analysis.

Results

A total of 153 cases seen between January 1992 to December 2002 were identified. The casenotes of 89 of these patients could be retrieved for retrospective evaluation. There were 41 (46.1%) SJS/TEN cases and 48 (53.9%) with EMO. All patients classified under SJS or TEN were confirmed to have distinctive skin lesions and involvement of no less than 2 mucous membranes.

All SJS/TEN cases were treated as inpatients or developed drug reactions during hospitalisation. Twelve (25%) EMO cases were treated at the emergency department as outpatients, while the remaining 36 (75%) were hospitalised.

The demographics of the patients are described in Table I. While no statistical significance was shown by chi-square analyses for gender and race distribution between the EMO and SJS/TEN groups, the mean age in the EMO group was significantly lower than the SJS/TEN group; 24.06 ± 22.51 years versus 35.41 ± 25.13 years. The ages of the patients ranged from 10 months to 79 years. CART analysis defined the breakpoint for age as 17.5 years. The binary covariate of ≥18 years was thus used in the subsequent univariate analysis to determine if age group was a predictor for the development of SJS/TEN.

There were 3 deaths based on all cause mortality for these 89 cases. One in the EMO group who died of a non-EM related cause of intracranial haemorrhage and 2 (4.9%) in the SJS/TEN group where multi-organ failure, a secondary complication directly attributed to SJS/TEN, was implicated. The definite causative agents identified in these 2 cases were Anarex[®], a combination product of paracetamol with orphenadrine citrate and allopurinol. A total of 11 (from 17 cases) and 18 (from 29 cases) definite causative agents were identified in EMO and SJS/TEN groups, respectively. The definite causative agents for each group are listed in Table II. There were 2 cases each in the EMO group that had skin eruptions attributed to viral infections and food versus none in the SJS/TEN group. Antimicrobials were the most common primary causative agents identified with beta-lactams emerging as the most common class of antibiotics causing skin eruptions. This was followed by NSAIDs in the EMO group [3 (6.25%)] and antiepileptics in the SJS/TEN group [9 (22%)]. Antimicrobials were also identified as a secondary but definite causative agent in another 2 SJS/TEN cases. Antiepileptics were not recorded to be a definite cause for EMO. At least 1 suspected agent was documented in an additional 19 EMO and 26 SJS/TEN cases respectively.

Of the 89 patients, 25 had a history of previous drug allergies, 8 (12.5%) in the EMO group and 17 (41.5%) in the SJS/TEN group. This prompted the use of previous drug allergies to be tested as a predictive covariate for SJS/TEN. The following covariates were tested in separate univariate analyses using the chi-square test to determine their significance – existing co-morbid conditions, age ≥18 years, gender, history of previous drug allergies, fever, pruritus, nausea and vomiting, antiepileptic usage and antimicrobial usage. The significant predictors were existing co-morbidities ($P = 0.001$), history of previous drug allergy ($P = 0.009$) and antiepileptic ($P = 0.001$) or antimicrobial usage ($P = 0.015$) at time of diagnosis. The same covariates were entered into a CART analysis to confirm the importance of their predictive values in the classification tree. The

TABLE I: DEMOGRAPHICS OF STUDY COHORT

Demographics	EM Only	SJS/TEN	P value
Gender			
Male	23	18	0.75
Female	25	23	
Race			
Chinese	36	29	0.67
Malay	7	10	
Indian	1	1	
Others	4	1	
Age			
Mean	24.06 ± 22.51	35.41 ± 25.13	0.027
Admission type			
Inpatient	36	41	0.001
Outpatient	12	0	
Cause for admission			
Drug reaction	17	35	<0.001
Others	31	5	

¹ Pharmacist, Department of Pharmacy, National University Hospital, Singapore

² Associate Professor, National University of Singapore and Consultant, Department of Medicine, National University Hospital, Singapore

Address of Correspondence: Dr Tham Lai San, Department of Pharmacy, National University Hospital, 5 Lower Kent Ridge Road, Singapore 119074.

⁺Dr Tambyah would like to dedicate this abstract to the memory of Prof Chan Heng Leong, Singapore's and one of the world's foremost authorities on SJS/TEN.

TABLE II: DEFINITIVE CAUSATIVE AGENTS IDENTIFIED

Classes of drugs	EM Group	SJS/TENS Group	Total
Antimicrobials (total)	6	15 ^a	21
Azithromycin	1	0	
Cephalexin	2	2	
Cefuroxime	1	0	
Cotrimoxazole	1	3	
Amoxycillin	1	5	
Cefazolin	0	1	
Penicillin	0	1	
Chloramphenicol	0	1	
Metronidazole	0	1	
Nystatin	0	1	
Antiepileptics	0	9	9
Phenytoin	0	1	
Phenobarbitone	0	2	
Carbamazepine	0	5	
Lamotrigine	0	1	
Xanthine Oxidase Inhibitor (Allopurinol)	0	1	1
NSAIDS ^b	3	3	6
Ibuprofen	3	0	
Naproxen	0	2	
Diclofenac	0	1	
Paracetamol	0	2 ^c	2
Others	4	2	6
Non-drug	4	0	4
Food	2	0	
Viral	2	0	
Unknown	31	12	43
Total	48	44 ^d	92 (89 cases)

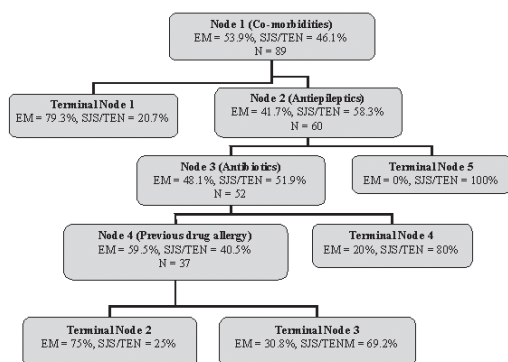
^a 3 cases with 2nd agent implicated^b Non-Steroidal Anti-Inflammatory Drugs^c including 1 case of Anarex(^d 3 cases with 2 agents defined

Fig. 1. Classification tree topology for predicting SJS/TEN from EM.

primary node splitters, in decreasing order of variable importance, were co-morbidities, previous history of drug allergy, antibiotic usage followed by antiepileptic usage. This resulted in a classification tree illustrated in Figure 1, with 5 terminal nodes. The relative cost was 0.525. The learning sample prediction success rate was 85.4% for EMO and 70.7% for SJS/TEN. The corresponding prediction success rates for test samples based on this model were 79.2% and 68.3%.

Other covariates that did not significantly predict risk of developing SJS/TEN included fever, gender, race, age ≥ 18 years and pruritus. An important perspective derived from this study was that mucocutaneous rash when accompanied by co-morbidities, previous history of drug allergies, antiepileptic or antimicrobial usages would predispose a patient to the risk of developing SJS/TEN. The accompanying generic symptoms of fever, nausea and/or vomiting are not indicative of the possibility of developing the more severe forms of EM. Although the mean age of SJS/TEN patients in our study was greater than that in the EMO group, stratification of

TABLE III: UNIVARIATE ANALYSIS OF PREDICTIVE COVARIATES

Covariates	EM only group	SJS/TEN group	P value
Existing co-morbidities*	25	35	0.001
Age = 18 years	26	27	0.263
History of drug allergy	8	17	0.009
Fever	23	24	0.317
Pruritis	19	10	0.127
Nausea, vomiting	2	1	0.653
Antiepileptics	0	9	0.001
Antimicrobials*	6	14 ^a	0.015

^a 1 case had 2 antimicrobials implicated

* by stepwise multivariate logistic regression analysis, these 2 covariates were found to be significantly associated with the development of SJS/TEN from EM

patients into 2 separate age groups using the CART breakpoint of 18 years confirmed that children and adolescents were not more likely to develop severe forms of skin eruptions.

Using a stepwise multivariable logistic regression model, the covariates found to be significantly associated with the development of SJS/TEN from EM were antibiotic usage ($P = 0.005$) and co-morbidities ($P = 0.032$).

Discussion

From the results of this study, 75% of EMO cases and all of SJS/TEN cases were treated as inpatients, accounting for 52 admissions out of 89 cases. Early identification of patients likely to progress from relatively benign cutaneous reactions to severe forms of rash, such as SJS and TEN, is important. From the hospital's perspective, this could potentially lead to a reduction in length of stay and mortality from further complications. TEN in Singapore was well described in a seminal study⁶ published nearly 20 years ago by Prof Chan Heng Leong in the *Journal of the American Academy of Dermatology*. He described 15 patients with TEN, all drug-induced with more than 75% epidermal loss in 7/15 cases. He also reported that the same drug could cause either the benign EMO or TEN. Similar studies have been conducted in the past in Seattle, Washington, comprising 37 cases of EM, SJS and TEN of which 16 were drug-induced;⁵ West Germany, 574 cases of SJS and TEN of which 380 were caused by drugs;⁷ France, 87 TEN cases of which 67 were due to drugs⁸ and Malaysia, 29 cases of EM, SJS and TEN of which 15 were drug-related.⁹ The culprit agents identified in this study, antiepileptics and antimicrobials, were consistent with causative agents in other published studies.^{5,8,10}

Two cases of EM were viral-induced while none of the SJS/TEN cases were linked with infections. *Mycoplasma pneumoniae* and *Herpes simplex* are well-recognised causes of EM and rarely SJS/TEN.¹¹⁻¹³ It was also noted that the SJS and TEN patients had a higher mean age and more had co-morbidities than those in the EMO group. This might not indicate age as a risk factor as these patients might be more exposed to different therapeutic agents due to their age and co-morbidities.

One drawback of this study was its retrospective nature, which limited the collection of detailed drug histories, incubation period, accurate rash descriptions, as well as the performance of skin biopsies to confirm diagnoses. The 10-year period also prevented the comparison of laboratory data.

Conclusions

This study identified 2 groups of drugs — antiepileptics and antimicrobials — as predictors of SJS and TEN. In addition, patients with a previous history of drug allergies and existing co-morbidities also render them as likely candidates for severe forms of cutaneous reactions when they present with drug-related rash. The results of this study suggested that patients with EM, due to these 2 classes of drugs, should be monitored closely for complications such as life-threatening mucocutaneous disorders.

REFERENCES

1. Bastuji-Garin S, Rzany B, Stern RS, Shear NH, Naldi L, Roujeau JC. Clinical classification of cases of toxic epidermal necrolysis, Stevens-Johnson syndrome and erythema multiforme. *Arch Dermatol* 1993; 129:92-6.
2. Roujeau JC. The spectrum of Stevens-Johnson syndrome and toxic epidermal necrolysis: a clinical classification. *J Invest Dermatol* 1994; 102:28S-30S.
3. Roujeau JC, Stern RS. Severe cutaneous adverse reactions to drugs. *N Engl J Med* 1994; 333:1600-7.
4. Revuz J, Penso D, Roujeau JC, Guillaume JC, Payne CR, Wechsler J, et al. Toxic epidermal necrolysis: Clinical findings and prognosis in 87 patients. *Arch Dermatol* 1987; 123:1160-5.
5. Chan HL, Stern RS, Arnandt KA, Langlois J, Jick SS, Jick H, et al. The incidence of erythema multiforme, Stevens-Johnson syndrome and toxic epidermal necrolysis: a population-based study with particular reference to reactions caused by drugs among outpatients. *Arch Dermatol* 1990; 126:43-7.
6. Chan HL. Observations on drug-induced toxic epidermal necrolysis in Singapore. *J Am Acad Dermatol* 1984; 10:973-8.
7. Schopf E, Stuhmer A, Ranzy B, Victor N, Zentgraf R, Kapp JF. Toxic epidermal necrolysis and Stevens-Johnson syndrome. An epidemiologic study from West Germany. *Arch Dermatol* 1991; 127:839-42.
8. Guillaume JC, Roujeau JC, Revuz J, Penso D, Touraine R. The culprit drugs in 87 cases of toxic epidermal necrolysis (Lyell's syndrome). *Arch Dermatol* 1987; 123:1166-70.
9. Kamaliah MD, Zainal D, Mokhtar N, Nazmi N. Erythema multiforme, Stevens-Johnson syndrome and toxic epidermal necrolysis in northeastern Malaysia. *Int J Dermatol* 1998; 37:520-3.
10. Wong KC, Kennedy PJ, Lee S. Clinical manifestations and outcomes in 17 cases of Stevens-Johnson syndrome and toxic epidermal necrolysis. *Aust J Dermatol* 1999; 46:131-4.
11. Macdonald A, Feiwei M. Isolation of herpes virus from erythema multiforme. *Br Med J* 1972; 3:570-1.
12. Stutman HR. Stevens-Johnson syndrome associated with *Mycoplasma pneumoniae* infection: evidence for cutaneous infections. *J Paediatr* 1987; 3:845.
13. Sanders DY, Johnson HW. Stevens-Johnson syndrome associated with *Mycoplasma pneumoniae* infection. *Am J Dis Child* 1971; 121:243-5.

Best Oral Presentation Award Finalist – Paramedical Disciplines

Chinese Version of Patient Rated Wrist Evaluation (PRWE): Cross-cultural Adaptation and Reliability Evaluation

W Xu,¹Dip (OT), C Seow,²OT (Hons)

Distal radius fracture is a very common injury, it accounts for one sixth of the fractures treated in the emergency room.¹ Despite advancing surgical and rehabilitation management of this injury, deformity due to this injury is not uncommon, and some can lead to permanent disability. Clinical evaluation systems, such as Gartland and Werley point system² and modified clinical scoring system of Green and O'Brien,³ have been widely used as clinical scoring system for evaluating distal radius fracture outcome. In recent years, standardised validated questionnaires and health-related quality of life evaluation have become more important in clinical outcomes measure, such as 36-item Short Form Health Survey (SF-36),⁴ Disability of the Arm, Shoulder, and Hand (DASH)⁵ and Patient Rated Wrist Evaluation (PRWE).⁶ SF-36 is a generic instrument, which allows cross-condition comparison in any population, but may not be sensitive enough to detect small but important changes related to a particular condition. Therefore, region-specific instruments such as DASH and PRWE have been introduced. PRWE is one instrument that is particular to wrist disorders, while DASH is for all upper extremity disorders.

PRWE was widely used in western literature to evaluate wrist disabilities.⁷⁻¹² However, it is not commonly used among Asian population, since there is no validated translated version available. Thus, there is a need to develop a validated Chinese version of PRWE with consideration of the language and culture differences. The present study was to perform a cross-cultural adaptation of the PRWE to Chinese and evaluate the reliability of the Chinese version in patients with distal radius fractures.

Materials and Methods*The Instrument*

PRWE is a 15-item questionnaire that equally rates wrist-related pain and disability in functional activities.⁶ It contains 5 questions pertaining to the severity and duration of the pain, which contribute to 50% of the total score. The functional items include 6 specific tasks and 4 questions in which patients rate their disability in the domains of self care, work, household work and recreation. The

functional items contribute to another 50% of the total score. Each item in the questionnaire is scored on a 0 to 10 numeric scale.⁶ The reliability and validity of this assessment tool have been studied in the western population; test-retest reliability was excellent (ICCs > 0.90). Validity assessment demonstrated that the instrument detected significant differences over time ($p < 0.01$).^{6,13} Responsiveness of PRWE, DASH and SF-36 in evaluating recovery after distal radius fracture has been compared; and PRWE was the most responsive questionnaires among the 3.¹⁴

Subjects

Distal radius fracture patients who 1) understand English or Chinese, 2) attend hand rehabilitation program in NUH from January 2002 to December 2002, and 3) had started on wrist mobilisation programme for at least 1 month were included in the study. Exclusion criteria were: age <18 years and/or inability to understand the questionnaire due to cognitive impairment or language difficulties. 21 subjects in the Chinese group (male 13; female 8) and 30 subjects in the English group (male 24; female 6) were recruited for the reliability study.

Adaptation Process

The English version of PRWE was translated into Chinese with conceptual translation by a group of bilingual experienced hand occupational therapists. The translation did not try to achieve "word for word" equivalence, but instead tried to capture the essential meaning of each item in the questionnaire. Face validity was established by introducing a 5-member review panel to critique the Chinese translation, and valid suggestions were taken to improve the translation of the questionnaire.

The version was translated back to English by 2 other bilingual healthcare professionals whose first language was English. Both were blind to the concepts being investigated. The translations were compared with the original PRWE questionnaire. Discussions were held with the translators to jointly "fine-tune" the Chinese translation.

Pilot testing was carried out on 23 patients with distal radius fracture (12 Chinese group; 11 English group) to gather and compare their feedback on suitability and acceptability of both the Chinese

¹ Occupational Therapist, Rehabilitation Centre, National University Hospital, Singapore² Senior Occupational Therapist, Rehabilitation Centre, National University Hospital, Singapore

Address of Correspondence: Mr Xu Weixin, Rehabilitation Centre, National University Hospital, 5 Lower Kent Ridge Road, Main Building Level 1, Singapore 119074.

and PRWE version. The feedbacks were gathered under 4 categories: 1) whether all the statements are easy to understand; 2) whether the activities listed in the questionnaire are relevant to the individual; 3) whether the scale of 0-10 is easy to use; and 4) whether it is fast to complete the questionnaire.

The final Chinese version of the PRWE was then evaluated with regards to reliability and internal consistency.

Reliability Analysis

This study was conducted on patients who sustained distal radius fracture and attended hand therapy programme at NUH. To establish test-retest reliability, the subjects were administered PRWE twice at a week's interval. Either the Chinese or English version of the PRWE was administered, depending on their language preference. Completed PRWE questionnaires were obtained from 51 patients. Test-retest reliability was calculated by computing intraclass correlation coefficient (ICC) for analysis. The ICC analysis was also performed separately for different subtests. Internal consistency of each item within both Chinese and English PRWE was measured by Cronbach's alpha coefficient. The Cronbach's alpha is based on the correlation of each item with the whole scale and the number of items that comprise the scale. The Cronbach's alpha can range from 0-1, and a coefficient of > 0.7 indicates good reliability.

Results

Adaptation

The pilot testing showed that majority of patients agreed that the questionnaires were clear and easy to use and most of the items were relevant to their daily life. The English group had slightly better feedback compared to the Chinese group (Table I).

Reliability

Test-retest reliability analysis is shown in Table II. The ICC for the Chinese version was 0.93 comparable to the English version of 0.94 in the current study, indicating excellent agreement between the scores from the test and retest. The different subtests for the Chinese version also showed high ICC, which ranges from 0.88-0.91.

Results of internal consistency are shown in Table III. Cronbach alpha was > 0.7 for all scales, which ranges from 0.94-0.98 for the Chinese version, indicating high correlation between each item and the whole scale.

Discussion

There has been an increase in research that evaluates clinical measures that are translated and adapted for different cultures.¹⁵ The benefit of culturally adapted instruments is that it allows comparison of outcome between countries, and utilising validated instruments from others saves the effort of reproducing the instruments. However, the social-cultural factors and cultural differences may influence the performance of a questionnaire and the results interpretation. For instance, during the adaptation process, one of the items in the specific activities category, "cut meat using a knife in my affected hand" was originally referring to a feeding task. But using knife for feeding is not a common practice in Chinese culture.

TABLE I: RESULT OF PILOT TESTING (% of subjects who agreed with statements)

	Easy to understand	Activity relevance	Easy to use scale	Fast to complete
Chinese group (n=12)	75%	92%	54%	42%
English group (n=11)	100%	82%	82%	100%

TABLE II: TEST-RETEST RELIABILITY

	Chinese version (n = 21) ICC	English version (n = 30) ICC
Pain	0.91	0.90
Specific activities	0.90	0.93
Usual activities	0.88	0.92
Total score	0.93	0.94

TABLE III: INTERNAL CONSISTENCY

	Chinese version (n = 42) Cronbach alpha	English version (n = 60) Cronbach alpha
Pain	0.94	0.93
Specific activities	0.94	0.96
Usual activities	0.97	0.92
Total score	0.98	0.98

In this study, Chinese adaptation of the PRWE was performed using a systematic standardised approach. Similar approaches were performed in the adaptation of other health instruments, such as the reliability and validity study of DASH Swedish version,¹⁶ and the validation of Arthritis Impact Measurement Scale Spanish format.¹⁷ The studies proceeded according to established guidelines: using focus group for quality control, back translation and pilot testing.

The present study produced the Chinese version of the PRWE, and the results showed high test-retest reliability and internal consistency. In this study, 1 week interval was chosen to minimise the patient's recall of the previous answers. If the interval is too long, patients may experience functional change due to the natural recovery process.

Our finding shows excellent reliability and internal consistency of the Chinese version of the PRWE. It should be a valuable tool in clinical research in wrist disorders and for clinicians to evaluate treatment outcome.

REFERENCES

1. Ark J, Jupiter JB. The rationale for precise management of distal radius fracture. *Orthop Clin North Am* 1993; 24:205-10.
2. Gartland JJ, Wertley CW. Evaluation of healed Colles' fracture. *J Bone Joint Surg* 1951; 33A:895-907.
3. Bradway JK, Amadio PC, Cooney WP. Open reduction and internal fixation of displaced, comminuted intra-articular fracture of distal end of radius. *J Bone Joint Surg* 1989; 71A:839-47.
4. Ware JEJ, Sherbourne CD. The MOS 36-item short-form health survey (SF36): conceptual framework and item selection. *Med Care* 1992; 30:473-83.
5. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand). *Am J Ind Med* 1996; 29:602-8.
6. MacDermid JC. Development of scale for patient rating of wrist pain and disability. *J Hand Ther* 1996; 9:178-83.
7. MacDermid JC, Richards RS, Roth JH. Distal radius fracture: a prospective outcome study of 275 patients. *J Hand Ther* 2001; vol no?:154-69.
8. MacDermid JC, Donner A, Richards RS, Roth JH. Patient versus injury factors as predictors of pain and disability six months after a distal radius fracture. *J Clin Epidemiol* 2002; 55:849-54.
9. Beaulé PE, Dervin GF, Giachino AA, Rody K, Grabowski J, Fazekas A. Self-reported disability following distal radius fractures: the influence of hand dominance. *J Hand Surg* 2000; 25A:476-82.
10. Kamezis IA, Fragkiadakis EG. Association between objective clinical variables and patient-rated disability of the wrist. *J Bone Joint Surg* 2002; 84B:967-70.
11. Konrath GA, Bahler S. Open reduction and internal fixation of unstable distal radius fractures: results using the trimmed fixation system. *J Orthop Trauma* 2002; 16:578-85.
12. Jupiter JB, Ring D, Weitzel PP. Surgical treatment of redisplaced fractures of the distal radius in patients older than 60 years. *J Hand Surg* 2002; 27:714-23.
13. MacDermid JC, Turgeon T, Richards RS, Beadle M, Roth JH. Patient rating of wrist pain and disability: a reliable and valid measurement tool. *J Orthop Trauma* 1998; 12:577-86.
14. MacDermid JC, Richards RS, Donner A, Bellamy N, Roth JH. Responsiveness of the short form-36, disability of the arm, shoulder, and hand questionnaire, patients-rated wrist evaluation, and physical impairment measurements in evaluating recovery after a distal radius fracture. *J Hand Surg* 2000; 25A:330-40.
15. Rosales RS, Delgado ES, de la Lastra-Bosch ID. Evaluation of the Spanish version of the DASH and carpal tunnel syndrome health-related quality-of-life instruments: cross-cultural adaptation process and reliability. *J Hand Surg* 2002; 27A:334-43.
16. Atroshi I, Gummesson C, Andersson B, Dahlgren E, Johnsson A. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire—reliability and validity of the Swedish version evaluated in 176 patients. *Acta Orthop Scand* 2000; 71:613-8.
17. Hendricson WD, Russell IJ, Prihoda TJ, Jacobson JM, Rogan A, Bishop GD, et al. Development and initial validation of a dual-language English-Spanish Format for the Arthritis Impact Measurement Scales. *Arthritis Rheum* 1989; 32:1153-9.