

Korean Version of the Scale for the Assessment and Rating of Ataxia in Ataxic Stroke Patients

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Objective To investigate the intra-rater and inter-rater reliability and usefulness of the Korean version of the Scale for the Assessment and Rating of Ataxia (K-SARA) in ataxic stroke patients.

Methods The original SARA was translated into Korean, back translated to English, and compared to the original version. Stroke patients (n=60) with ataxia were evaluated using the K-SARA by one physiatrist and one occupational therapist. All subjects were rated twice. We divided the subjects into 5 groups by Functional Ambulation Category (FAC) and 3 groups based on the ataxia subscale of the National Institutes of Health Stroke Scale (NIHSS). The mean K-SARA scores representing each group of FAC and the ataxia subscale of NIHSS were compared.

Results The test-retest correlation coefficient of the K-SARA was 0.997 by the therapist and 1.00 by the physiatrist ($p < 0.001$). The inter-rater correlation coefficient of the K-SARA was 0.985 ($p < 0.001$). The ataxia subscale of NIHSS did not correlate with K-SARA. There was a significant difference in the mean K-SARA score by FAC ($p < 0.001$).

Conclusion K-SARA is a reliable and valid measure of ataxia in stroke patients in Korea.

Keywords Ataxia, Ataxia assessment, Stroke, Rehabilitation

INTRODUCTION

Ataxia is known to occur in a number of neurologic diseases, such as stroke, and often has both clinical and diagnostic significance. Although muscle power is relatively well maintained, appropriate motor functions

cannot be performed due to dysmetria and abnormal motor responses [1]. Also, ataxia affects the neurological function of motor coordination, which may in turn affect fundamental activities, such as eye movement, speech, muscle tone, gait, and stance [2]. Ataxia may disturb performance of activities important for daily living as well. Therefore, assessment of ataxia is important for the planning and goal setting of rehabilitation treatment. The evaluation tools used for ataxia assessment include International Cooperative Ataxia Rating Scale (ICARS) [3] and Friedreich Ataxia Rating scale (FARS) [4]. However, ICARS consists of 19 items that the application of this scale in daily practice is limited. FARS is not suitable for ataxic stroke patients, because it was developed for the evaluation of Friedreich ataxia. The Scale for the Assess-

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ment and Rating of Ataxia (SARA) is a new ataxia scale that was initially validated in spinocerebellar ataxia (SCA) patients. It includes 8 items reflecting neurological manifestations of cerebellar ataxia, but does not consider non-ataxia symptoms [5].

We performed this study to translate SARA into Korean and investigate the intra-rater and inter-rater reliability of the Korean version of the SARA (K-SARA) for ataxic stroke patients.

MATERIALS AND METHODS

Translation of SARA into the Korean language

We obtained permission from Tanja Schmitz-Hubsch, the original author of SARA (Appendix 1), for the Korean translation of the SARA. Two physiatrists fluent in English translated the SARA into the Korean language, version 1-A and 1-B, and they discussed the 2 versions. A reconciled version (version 2) was achieved by consensus and it was back-translated into English by 2 other translators (who majored in English Literature and skillful English and Korean; version 3-A and 3-B). Version 3-A and 3-B were reviewed and compared with the original version by 2 physiatrists.

A preliminary study regarding the final product (K-SARA, Appendix 2) was conducted for ataxic stroke patients who were admitted to the rehabilitation unit of Konkuk University Medical Center.

Study population

The subjects of this study consisted of 60 ataxic stroke patients who were admitted to the rehabilitation unit of Konkuk University Medical Center between September 1, 2012 and July 31, 2013. Patients were excluded if they had previous brain diseases, difficulty in participating due to severe cognitive dysfunction, or severe orthopedic problems, such as loss of their lower extremities, fracture or arthritis, or subarachnoid hemorrhage.

Assessment of K-SARA

K-SARA has 8 items with a total score rating from 0 (no ataxia) to 40 (most severe ataxia): 1, gait (score 0 to 8); 2, stance (score 0 to 6); 3, sitting (score 0 to 4); 4, speech disturbance (score 0 to 6); 5, finger chase (score 0 to 4); 6, nose-finger test (score 0 to 4); 7, fast alternative hand movement (score 0 to 4); and 8, heel-shin slide (score 0 to 4). Limb kinetic functions (items 5 to 8) are rated in-

dependently for both sides, and the arithmetic mean of both sides is included in the SARA total score.

All 60 patients were assessed on the same day by 2 examiners (1 physician and 1 occupational therapist). The first assessment was conducted on the day of admission to the rehabilitation unit. A second assessment was conducted the next day to evaluate the inter-test consistency of the test. Rehabilitation treatment or drug adjustment was not performed between the 2 assessments.

Usefulness of K-SARA

The National Institutes of Health Stroke Scale (NIHSS) and Functional Ambulation Category (FAC) were as-

Table 1. Clinical and demographic data of the participants (n=60)

Variable	Value
Sex (male:female)	28:32
Age (yr)	64.03±12.12
Disease duration (day)	37.13±42.57
Stroke type	
Infarction	36 (60.0)
Hemorrhage	24 (40.0)
Stroke side	
Right	14 (23.3)
Left	18 (30.0)
Bilateral	28 (46.7)
Site of lesion	
ACA territory	4 (6.67)
MCA territory	18 (30.3)
PCA territory	6 (10.0)
Posterior circulation	14 (23.3)
SAH	18 (30.0)
NIHSS	2.93±1.65
FAC	4.03±1.46
K-BBS	35.43±18.09
K-MMSE	19.60±6.52
K-MBI	67.27±25.34

Values are presented as mean±standard deviation or number (%).

ACA, anterior cerebral artery; MCA, middle cerebral artery; PCA, posterior cerebral artery; SAH, subarachnoid hemorrhage; NIHSS, National Institutes of Health Stroke Scale; FAC, Functional Ambulation Category; K-BBS, Korean version of Berg Balance Scale; K-MMSE, Korean version of Mini-Mental State Examination; K-MBI, Korean version of Modified Barthel Index.

sessed in all subjects. The patients were divided into 3 groups by the ataxia subscale of NIHSS: 0, no ataxia symptom; 1, ataxia present in the upper limb or lower limb; and 2, ataxia present in the upper limb and lower limb. Additionally, ambulation status was divided into 5 groups according to the FAC: 0, nonfunctional ambulator; 1, ambulator dependent for physical assistance (level II); 2, ambulator dependent for physical assistance (level I); 3, ambulator dependent for supervision; 4, ambulator independent level surface only; and 5, ambulator independent. The mean K-SARA score was compared between the groups.

Statistical analysis

We used the intraclass correlation coefficients (ICC) in order to evaluate the reliability of the K-SARA score. An observed p -value <0.05 was considered statistically significant. Statistical analyses were conducted using SPSS ver. 17.0 for Windows (SPSS Inc., Chicago, IL, USA).

RESULTS

General characteristics of the patients

We evaluated sixty patients with ataxic stroke. Table 1 summarized their demographic and clinical characteristics. The mean age at examination was 64.03 ± 12.12 (range, 42 to 87 years). Among the patients, 28 were

Table 2. Inter-rater reliability for all items measured with correlation coefficients

	kappa value	p-value
Gait	0.918	0.0001
Stance	0.854	0.0001
Sitting	1	0.0001
Speech	0.943	0.0001
Finger	0.963	0.0001
Finger-to-nose test	0.787	0.0001
Fast alternative movement	0.808	0.0001
Heel to shin	0.706	0.0001

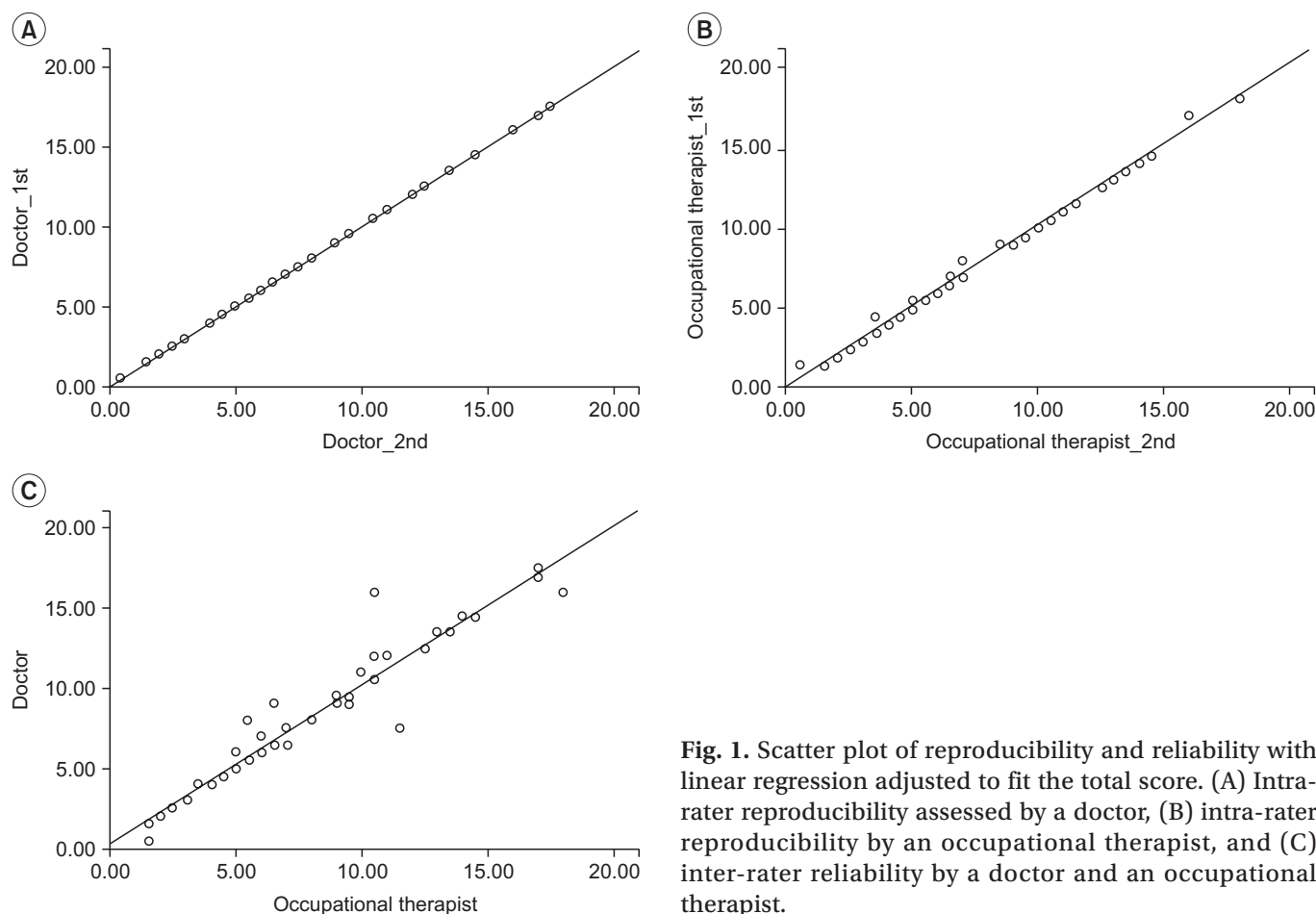


Fig. 1. Scatter plot of reproducibility and reliability with linear regression adjusted to fit the total score. (A) Intra-rater reproducibility assessed by a doctor, (B) intra-rater reproducibility by an occupational therapist, and (C) inter-rater reliability by a doctor and an occupational therapist.

male and 32 were female. The disease duration was 37.13 ± 42.57 days.

The inter-rater reliability for K-SARA

Inter-rater reliability was analyzed based on the results of assessment of each item of K-SARA by 1 occupational therapist and 1 physician. Inter-rater reliability of the total K-SARA score was very high, with an ICC of 0.985 ($p < 0.01$). The inter-rater consistency of each item resulted in weighted kappa scores showing a high level of consistency (Table 2).

The intra-rater reliability for each item of the K-SARA

A high reliability was shown for the 2 visits (ICC=1) when the physiatrist assessed the patients, and a sub-

stantial reliability (ICC=0.965) when the occupational therapist assessed the patients (Fig. 1). Most items had good test-retest reliability with ICCs above 0.90 (Table 3).

Usefulness of K-SARA

There was no significant difference in the mean K-SARA between the groups divided by the ataxia subscale of NIHSS (Fig. 2). The K-SARA score for the gait status had means of 15.12, 12.41, 9.92, 6.03, 5.18, and 4.16 points for FAC grades 0, 1, 2, 3, 4, and 5, respectively ($p < 0.001$) (Fig. 3). Significant differences in the K-SARA scores were found in the aforementioned classifications.

DISCUSSION

The objective of this study was to translate and validate SARA into Korean. In order to perform this goal, 60 ataxic stroke patients were assessed using the K-SARA. The results showed high intra-rater reliability not only for physiatrist but also occupational therapist and high inter-rater correlation.

Recently, many disease-specific scales for some types of ataxic disorders have been developed, including FARS for Friedreich ataxia [4] and the Unified Multiple System Atrophy Rating Scale (UMSARS) [6] for multiple system atrophy. Schmahmann et al. [7] developed a Brief Ataxia Rating Scale (BARS), based on a modified form of the International Cooperative Ataxia Rating Scale (ICARS). The ICARS has been widely used as a tool for the evaluation of the severity and treatment efficacy of cerebellar ataxia.

Table 3. Test-retest reliability for all items measured with correlation coefficients

	Doctor	Occupational therapist
Gait	1	0.998
Stance	1	0.993
Sitting	1	0.965
Speech	1	0.992
Finger chase	1	1
Finger-to-nose test	1	0.979
Fast alternative movement	1	0.986
Heel to shin	1	0.912

Values are presented as weighted kappa ($p < 0.01$).

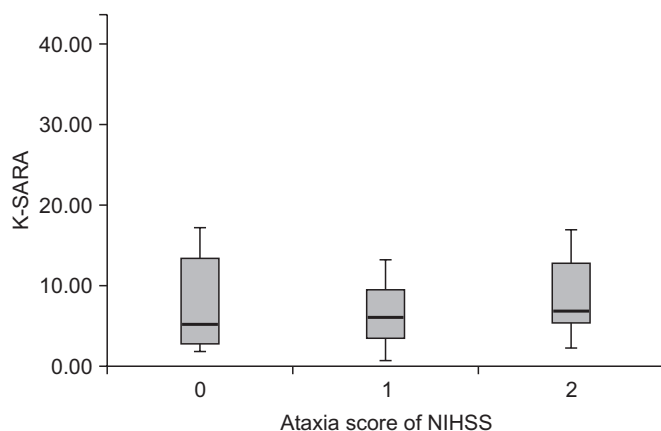


Fig. 2. Korean version of the Scale for the Assessment and Rating of Ataxia (K-SARA) score according to ataxia score of the National Institutes of Health Stroke Scale (NIHSS).

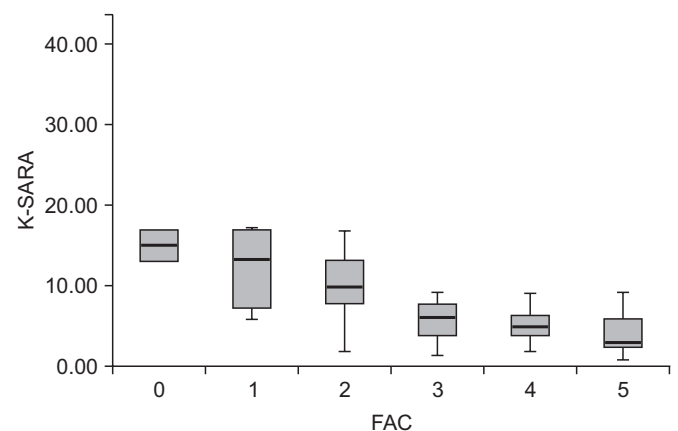


Fig. 3. Korean version of the Scale for the Assessment and Rating of Ataxia (K-SARA) score according to ambulation status by Functional Ambulation Category (FAC).

ICARS is a semi-quantitative 100-point scale, consisting of 19 items divided into 4 subscores: posture and gait, kinematic functions, speech, and ocular movements. However, the daily use of this scale in ataxic patients is difficult due to its many assessment items [3].

Schmitz-Hubsch et al. [5] recently proposed a SARA. This new assessment tool has fewer assessment items than ICARS and therefore has the advantage of easier daily assessment of ataxia. SARA has been demonstrated for its reliability and validity in 64 ataxic patients [8]. Studies on the usefulness of SARA have been conducted to compare it with the existing ICARS and Barthel Index in cerebellar ataxia patients [9]. Kim et al. [10] reported that SARA is useful in ataxic stroke patients and showed a significant correlation with the Modified Barthel Index, Berg Balance Scale, and gait status. Thus, SARA has been proven helpful in predicting the dependency of ADL and gait status and developing treatment plans [10].

However, these tools were developed in the West and verified in English. A standardized assessment tool for Koreans was needed, with translation and modification suited to the Korean language and culture.

Therefore, we translated the SARA to Korean with adequate internal consistence. We were not required to change the words or sentences as the scale was very simple. The assessment time of K-SARA was within 5 minutes. All investigators commented that the Korean version was as easy to understand as the original version. Additionally, the intra-rater reliability of K-SARA (ICC=0.965 or ICC=1) was similar with intra-rater reliability (ICC=0.99) of the original version [8], indicative of no problems in the Korean adaptation of SARA items.

To establish the treatment goal and predict the prognosis of stroke patients during rehabilitation treatment, their status before the initiation of rehabilitation treatment must be accurately assessed.

The NIHSS is used for evaluation of initial impairment and follow-up of the neurologic status in stroke patients [11,12]. NIHSS is useful in the assessment of overall neurologic status of stroke patients, but has just 1 item to assess limb ataxia. The finger-nose-finger test and heel to shin test use the following scale: 0, no ataxia symptoms; 1, ataxia present in the upper limb or lower limb; and 2, ataxia present in the upper limb and lower limb. However, these 2 tests only assess the presence of limb ataxia, which are insufficient for the assessment of the

overall ataxia symptoms, including truncal ataxia. There are 1 item to evaluate dysarthria (dysarthria score of K-SARA=6) and 3 items to evaluate truncal ataxia such as sitting and standing balance and gait status (total truncal ataxia score of K-SARA=18), other than items that evaluate limb ataxia (total limb score of K-SARA=16) in K-SARA. Additionally, more detailed evaluation for limb ataxia is possible because there are 2 more items for evaluation of limb ataxia (finger chase test, fast alternative hand movements test), besides items of NIHSS (nose-finger test, heel-shin test). We found no difference in K-SARA score between 0, 1, and 2 points. As mentioned above, the main reason for this may lie in the limitation of NIHSS to assessment for truncal ataxia or severity of limb ataxia. Thus, if ataxia symptoms are present, the K-SARA should be evaluated for more appropriate treatment planning.

K-SARA also showed significant differences in scores depending on the gait status assessed by FAC. The lower FAC showed higher K-SARA score. The results presented here closely resembled those previously reported in ataxia stroke patients [10], where patients with more severe ataxia showed poor gait status. Proper management planning can be accomplished by predicting the patient's balance and gait status by K-SARA.

In conclusion, the SARA was translated and validated into Korean language with good reliability and validity. The Korean SARA can be clinically useful for disorder assessment and rehabilitation planning.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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Appendix 1. The Scale for the Assessment and Rating of Ataxia (SARA)

Scale for the Assessment and Rating of Ataxia (SARA)	
<p>1) Gait</p> <p>Proband is asked (1) to walk at a safe distance parallel to a wall including a half-turn (turn around to face the opposite direction of gait) and (2) to walk in tandem (heels to toes) without support.</p> <p>0. Normal, no difficulties in walking, turning and walking tandem (up to one misstep allowed)</p> <p>1. Slight difficulties, only visible when walking 10 consecutive steps in tandem</p> <p>2. Clearly abnormal, tandem walking > 10 steps not possible</p> <p>3. Considerable staggering, difficulties in half-turn, but without support</p> <p>4. Marked staggering, intermittent support of the wall required</p> <p>5. Severe staggering, permanent support of one stick or light support by one arm required</p> <p>6. Walking >10 m only with strong support (two special sticks or stroller or accompanying person)</p> <p>7. Walking <10 m only with strong support (two special sticks or stroller or accompanying person)</p> <p>8. Unable to walk, even supported</p> <p>Score</p>	<p>2) Stance</p> <p>Proband is asked to stand (1) in natural position, (2) with feet together in parallel (big toes touching each other) and (3) in tandem (both feet on one line, no space between heel and toe). Proband does not wear shoes, eyes are open. For each condition, three trials are allowed. Best trial is rated.</p> <p>0. Normal, able to stand in tandem for >10 s</p> <p>1. Able to stand with feet together without sway, but not in tandem for >10 s</p> <p>2. Able to stand with feet together for >10 s, but only with sway</p> <p>3. Able to stand for >10 s without support in natural position, but not with feet together</p> <p>4. Able to stand for >10 s in natural position only with intermittent support</p> <p>5. Able to stand >10 s in natural position only with constant support of one arm</p> <p>6. Unable to stand for >10 s even with constant support of one arm</p> <p>Score</p>
<p>3) Sitting</p> <p>Proband is asked to sit on an examination bed without support of feet, eyes open and arms outstretched to the front.</p> <p>0. Normal, no difficulties sitting >10 s</p> <p>1. Slight difficulties, intermittent sway</p> <p>2. Constant sway, but able to sit >10 s without support</p> <p>3. Able to sit for >10 s only with intermittent support</p> <p>4. Unable to sit for >10 s without continuous support</p> <p>Score</p>	<p>4) Speech disturbance</p> <p>Speech is assessed during normal conversation.</p> <p>0. Normal</p> <p>1. Suggestion of speech disturbance</p> <p>2. Impaired speech, but easy to understand</p> <p>3. Occasional words difficult to understand</p> <p>4. Many words difficult to understand</p> <p>5. Only single words understandable</p> <p>6. Speech unintelligible/anarthria</p> <p>Score</p>

5) Finger chase**Rated separately for each side**

Proband sits comfortably. If necessary, support of feet and trunk is allowed. Examiner sits in front of proband and performs 5 consecutive sudden and fast pointing movements in unpredictable directions in a frontal plane, at about 50% of proband's reach. Movements have an amplitude of 30 cm and a frequency of 1 movement every 2 seconds. Proband is asked to follow the movements with his index finger, as fast and precisely as possible. Average performance of last 3 movements is rated.

0. No dysmetria

1. Dysmetria, under/overshooting target <5 cm
2. Dysmetria, under/overshooting target <15 cm
3. Dysmetria, under/overshooting target >15 cm
4. Unable to perform 5 pointing movements

Score	Right	Left
Mean of both sides (R+L)/2		

7) Fast alternating hand movements**Rated separately for each side**

Proband sits comfortably. Of necessary, support of feet and trunk is allowed. Proband is asked to perform 10 cycles of repetitive alteration of pro- and supinations of the hand on his/her thigh as fast and as precise as possible. Movement is demonstrated by examiner at a speed of approximately 10 cycles within 7 seconds. Exact times for movement execution have to be taken.

0. Normal, no irregularities (performs <10 s)

1. Slightly irregular (performs <10 s)
2. Clearly irregular, single movements difficult to distinguish or relevant interruptions, but performs <10 s
3. Very irregular, single movements difficult to distinguish of relevant interruptions, performs >10 s
4. Unable to complete 10 cycles

Score	Right	Left
Mean of both sides (R+L)/2		

6) Nose-finger test**Rated separately for each side**

Proband sits comfortably. If necessary, support of feet and trunk is allowed. Proband is asked to point repeatedly with his index finger from his nose to examiner's finger which is in front of the proband at about 90% of proband's reach. Movements are performed at moderate speed. Average performance of movements is rated according to the amplitude of the kinetic tremor.

0. No tremor

1. Tremor with an amplitude <2 cm
2. Tremor with an amplitude <5 cm
3. Tremor with an amplitude >5 cm
4. Unable to perform 5 pointing movements

Score	Right	Left
Mean of both sides (R+L)/2		

8) Heel-shin slide**Rated separately for each side**

Proband lies on examination bed, without sight of his legs. Proband is asked to lift one leg, point with the heel to the opposite knee, slide down along the shin to the ankle, and lay the leg back on the examination bed. The task is performed 3 times. Slide-down movements should be performed within 1 second. If proband slides down without contact to shin in all three trials, rate 4.

0. Normal

1. Slightly abnormal, contact to shin maintained
2. Clearly abnormal, goes off shin up to 3 times during 3 cycles
3. Severely abnormal, goes off shin 4 or more times during 3 cycles
4. Unable to perform the task

Score	Right	Left
Mean of both sides (R+L)/2		

Appendix 2. Korean version of the Scale for the Assessment and Rating of Ataxia (K-SARA)

운동실조의 평가와 평가 스케일	
<p>1) 걷기</p> <p>환자는 (1) 벽으로부터 안전 거리를 유지하며 벽과 평행하게 걸으면서 반바퀴 돌기(진행 방향과 반대 방향으로 돌기)와 (2) 도움 없이 일자 보행(한 발의 발꿈치와 다른 발의 발가락이 맞닿도록)을 수행한다.</p> <p>0. 정상 보행, 반바퀴 돌기와 일자 보행에 제한이 없다. (한 번 헛디딤은 허용한다.)</p> <p>1. 약간 어려움, 계속해서 10걸음 일자 보행을 할 때만 약간 어려워한다.</p> <p>2. 분명한 어려움, 일자 보행을 10걸음 이상 수행하지 못한다.</p> <p>3. 상당한 흔들림, 반바퀴 돌기에서 어려움이 있으나 도움 없이 걸을 수는 있다.</p> <p>4. 뚜렷한 흔들림, 간헐적으로 손으로 벽을 짚으면서 걷는다.</p> <p>5. 심한 흔들림, 보행 시 한 개의 지팡이를 계속해서 이용하거나 한쪽 팔에 가벼운 지지가 필요하다</p> <p>6. 양손에 지팡이를 짚거나 워커 등을 사용하여 강력한 도움을 받아야만 10미터 이상 걸을 수 있다.</p> <p>7. 양손에 지팡이를 짚거나 워커 등을 사용하여 강력한 도움을 받아도 10미터 이상 걸을 수 없다.</p> <p>8. 도움을 받아도 전혀 걸을 수 없다.</p> <p>점수</p>	<p>2) 서기</p> <p>환자는 (1) 편한 자세로 서기, (2) 양쪽 발을 가지런히 모으고 서기(양쪽 발의 엄지 발가락이 서로 닿도록 한다.) (3) 일자 서기(한 쪽 발의 발꿈치와 다른 쪽 발의 발가락을 붙이고 일자로 선다.)를 수행한다. 환자는 신발을 신지 않고 눈을 뜬 상태로 바로 선다. 각각의 과제마다 3회씩 수행하고, 가장 잘 수행한 점수를 기록한다.</p> <p>0. 정상, 10초 이상 일자 서기를 수행할 수 있다.</p> <p>1. 발 모으고 서기를 흔들림 없이 수행할 수 있으나, 일자 서기를 10초 이상 수행할 수 없다.</p> <p>2. 발 모으고 서기를 10초 이상 할 수 있으나 몸이 흔들린다.</p> <p>3. 편한 자세에서 도움 없이 10초 이상 설 수 있으나 발 모으고 서기는 수행하지 못한다.</p> <p>4. 편한 자세에서 10초 이상 설 수 있으나 간헐적인 지지가 필요하다.</p> <p>5. 계속해서 한쪽 팔로 지지해야 중립자세에서 10초 이상 설 수 있음</p> <p>6. 한쪽 팔로 지속적으로 지지하여도 10초 이상 설 수 없음</p> <p>점수</p>
<p>3) 앉기</p> <p>환자는 양발이 지면에 닿지 않도록 침대에 걸터 앉은 후, 눈을 뜨고 양팔을 앞으로 쭉 뻗는다.</p> <p>0. 정상, 10초 이상 앉는데 어려움이 없다.</p> <p>1. 약간의 어려움, 간헐적으로 몸이 흔들린다.</p> <p>2. 지속적으로 몸이 흔들리지만 도움 없이 10초 이상 앉아 있을 수 있다.</p> <p>3. 간헐적인 도움이 있어야만 10초 이상 앉을 수 있다.</p> <p>4. 계속해서 도와주어도 10초 이상 앉아 있을 수 없다.</p> <p>점수</p>	<p>4) 구어장애</p> <p>구어는 평상 시처럼 대화를 하면서 평가한다</p> <p>0. 정상</p> <p>1. 구어 장애가 의심된다.</p> <p>2. 구어 장애가 있으나 말하는 것을 이해하기 쉽다.</p> <p>3. 몇몇 단어는 이해하기 어렵다.</p> <p>4. 많은 단어를 이해하기 어렵다.</p> <p>5. 한 단어 정도만 이해할 수 있다.</p> <p>6. 말하는 것을 전혀 이해할 수 없다.</p> <p>점수</p>

5) 손가락 따라가기 (Finger chase)

양손을 따로 평가한다

환자는 편한 자세로 앉는다. 필요한 경우 발이나 몸통을 지지해주는 것은 허용된다. 평가자는 환자가 손을 뻗어 닿을 수 있는 거리의 50% 정도 되는 전면에 무작위 방향으로 연속적이고 빠른 손가락 포인팅 동작을 수행한다. 동작은 30센티미터 진폭을 갖고 2초에 한 번 정도 수행한다. 환자는 자신의 검지로 가급적 빠르고 정확하게 평가자의 손가락을 따르도록 한다. 마지막 3회 수행 동작의 평균 점수를 기록한다.

0. 빠르고 정확하게 포인팅 동작을 수행한다.

1. 겨냥 이상, 차이가 목표 지점에서 위아래 5센티미터 미만이다.
2. 겨냥 이상, 차이가 목표 지점에서 위아래 15센티미터 미만이다.
3. 겨냥 이상, 차이가 목표 지점에서 위아래 15센티미터 이상이다.
4. 5회의 포인팅 동작을 수행하지 못한다.

점수	오른쪽	왼쪽
평균 (오른쪽+왼쪽)/2		

7) 손바닥 빨리 뒤집기 (Fast alternating hand movements)

양손을 따로 평가한다

환자는 편한 자세로 앉는다. 필요한 경우 발이나 몸통을 지지해주는 것은 허용된다. 환자는 자신의 허벅지 위에 손을 올려놓고 최대한 빠르고 정확하게 반복적으로 앞침과 뒤침을 10번 시행한다. 평가자는 약 7초에 10번정도 손바닥 뒤집기를 수행하는 빠르기로 시범을 보여준다. 동작 수행의 정확한 시간을 측정한다.

0. 정상, 동작이 규칙적이며 수행 속도는 10초 미만이다.

1. 동작이 약간 불규칙하나 수행속도는 10초 미만이다.
2. 동작이 명확하게 불규칙하다. 각 동작을 하나하나 구별하기 어렵고, 중간에 멈추기도 하지만, 전체 수행 시간은 10초 미만이다.
3. 동작이 매우 불규칙하다. 각 동작을 하나하나 구별하기 어렵고, 중간에 멈추기도 한다. 전체 수행 시간은 10초 이상이다.
4. 10번 수행을 채우지 못한다.

점수	오른쪽	왼쪽
평균 (오른쪽+왼쪽)/2		

6) 코-손가락 검사 (Nose-finger test)

양손을 따로 평가한다

환자는 편한 자세로 앉는다. 필요한 경우 발이나 몸통을 지지해주는 것을 허용한다. 환자에게 자신의 검지를 반복적으로 자신의 코와 평가자의 검지 사이를 왕복하면서 짚도록 한다. 검사자의 검지는 환자가 손을 뻗어 닿을 수 있는 거리의 90% 지점에 위치하도록 한다. 동작은 중간 속도로 수행하도록 한다. 점수는 운동성 떨림의 평균 진폭으로 측정한다

0. 떨림이 없다.

1. 떨림, 2센티미터 미만의 진폭으로 떨린다.
2. 떨림, 5센티미터 미만의 진폭으로 떨린다.
3. 떨림, 5센티미터 이상의 진폭으로 떨린다.
4. 5회의 포인팅 동작을 수행하지 못한다.

점수	오른쪽	왼쪽
평균 (오른쪽+왼쪽)/2		

8) 발꿈치-정강이 검사 (Heel-shin slide)

양발을 따로 평가한다

환자는 천장을 보고 침대에 반듯하게 눕는다. 환자는 한 쪽 다리를 올려서 발꿈치로 반대쪽 다리의 무릎을 짚도록 하고 정강이를 따라 발목까지 미끄러져 내려간 후 다시 검사 침대에 내려놓는다. 과제는 3회 수행한다. 1초 이내에 미끄러져 내려가는 동작을 수행하여야 한다. 3회 모두 발꿈치가 정강이에 닿지 않은 채 움직이면 4점으로 평가한다.

0. 정상

1. 약간의 비정상, 그러나 발꿈치가 정강이에 닿는 것은 유지된다.
2. 분명한 비정상, 3회를 수행하는 동안 발꿈치가 정강이에서 3번이내로 벗어난다.
3. 심한 비정상, 3회를 수행하는 동안 발꿈치가 정강이에서 4번 이상 벗어난다.
4. 과제를 수행할 수 없다.

점수	오른쪽	왼쪽
평균 (오른쪽+왼쪽)/2		