Review
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ASIA Update-ASIA Impairment Scale: Level Determination, Classification, and Case Examples

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Abstract

Performing a standardized physical examination is useful for spinal cord injury patients during follow-up, monitoring the effects of different treatments, and building a standard terminology among the professionals professionals dealing with the disease. The most commonly used method in assessment of spinal cord injury patients is the International Standards for Neurological Classification of Spinal Cord Injury developed by American Spinal Cord Association (ASIA) and International Spinal Cord Society (ISCoS). The purpose of this report is to summarize the ASIA Impairment Scale, a part of the International Standards for Neurological Classification of Spinal Cord Injury, and summarize leveling and grading with examples.
Keywords: Spinal cord injury, ASIA Impairment Scale, classification

Introduction

A standardized physical examination is the most accurate method for the assessment of patients with spinal cord injury. The International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) is the most prominent standardized clinical grading and classification method; it was developed by the American Spinal Injury Association (ASIA) and approved by the International Spinal Cord Society (ISCoS) (1). The aims of these standards are to accurately define the severity and level of lesions, provide common and reliable information among research centers and centers for patient care, and provide data about the prognosis of the patient and efficiency of the treatment (1,2).

The priority of the assessment is to obtain data from sensory, motor, and anorectal examinations of a patient with spinal cord injury according to the international standards and to record the data obtained to the ASIA Impairment Scale (AIS). The latest version of the revised 2013 ASIA form has been translated into Turkish and published with the permission of ASIA (Appendix 1) (2,3).Before discussing the classification the last revision of this scale used in the assessment of patients with spinal cord injury is going to be reviewed.

The figure that represents body dermatomes in the revised 2013 ASIA form has been positioned in the center of the first page, and the examination page has been divided into left and right sections. In the Turkish abbreviations, "Ğ" is used for right and "L" is used for left. The same myotome and dermatome levels are positioned at the same level (i.e., the C5 myotome and C5 dermatome are at the same level) (2).

There have been some changes on the logos and titels of the first page. The logo of ISCoS has been added to the both sides of the form and a signature part has been implemented. The small boxes that will be used in the sensory and motor assessments have been enlarged slightly. The assessments of sacral sparing (voluntary anal contraction and deep anal pressure) have been positioned with the same level of the S4-5 dermatome

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levels, and the frames of the small boxes have been darkened and made more pronounced. The boxes for the assessment of needle sensation have been shadowed by 10% to underline the difference between these boxes and the light touch (2).

The Single Neurological Level box has been renamed as "Neurological Injury Level." The neurological levels on the front side have been given numbers compatible with the classification steps stated on the back side of the form (2).

The ASIA and ISCoS logos have been added to the back side of the form. A more detailed neurological injury level description has been implemented. One of the most important differences in the scale is the addition of key muscles function levels that were absent in the previous scale and the statement of levels (Table 1). Muscle functions other than those of the key muscles may be used to differentiate between AIS B and AIS C. These muscle functions and root levels have been added to establish a common language for classification. Various references have been used to define the root levels of the muscles; if different myotomes have been proposed for the same muscle functions in different references, upper myotomes have been preferentially used. Performing assessments using muscle functions instead of muscle names may clarify the process. For muscle functions other than those of key muscles, no standardized assessments have been defined (2,4).

Classification

After the examination of a patient with spinal cord injury, the next step is classification. The classification process has been defined with the classification steps on the back page of the assessment form and numbered on the bottom of the first page (Table 2).

Case 1

The first step is the assessment of the sensory level. The sensory level is the most caudal segment in which the needle sensation and light touch sensation are present (2 points); it is individually defined for the left and right sides (5). In Case 1 (Figure 1), the sensory level for the right and left sides is C7 (C7/C7).

The assessment of the right and left motor levels is the second step. The motor level is defined as the lowest myotome with grade 3 muscle strength as long as the muscles higher than the level are fully functional (grade 5).These levels are individually defined for the right and left parts. For the myotomes that cannot be clinically assessed, i.e., C1–C4, T2–L1, and S2–S5 levels, the motor level is assumed to be the sensory level (5).

For Case 1 (Figure 1), the right and left C7 myotomes are 4 and 3 grade muscle strength respectively; because upper key muscles are 5 muscle grade in Case 1 for the right and left sides, the motor level is C7 (C7/C7).

Determining the neurological injury level (NIL) is the third step. As long as the sensory and motor functions are normal, NIL defines the most caudal level in which the sense has a muscle power grade (3/5) that can overcome gravity. When four different motor and sensory levels are defined as the right sensory, left sensory, right motor, and left motor levels, NIL of the patient is the most rostral (5). For Case1, as the sensory and motor levels are C7 for the right and left parts, NIL is C7.

The fourth step is assessing if the injury is complete or incomplete. In a complete injury, there is no sacral sparing (no sensory or motor function on S4-5).

Sacral sparing signifies the retention of the sensory and motor functions on the most caudal segments during examination (light touch or needle sensation on the S4-5 dermatome, deep anal pressure, or voluntary anal contraction).

In an incomplete injury, sacral sparing exists, i.e., sensory and motor functions are partially observed on S4-5 (5). In Case 1 (Figure 1), due to the absence of sensory sparing, deep anal pressure, or voluntary anal contraction, there is no sacral sparing; thus, the patient is completely injured and defined as C7 AIS A.

In the fifth step, AIS is determined (Table 3). In AIS, the patient is categorized from A to E in five compartments. The patient in Case 1 was completely injured and was thus classified as AIS A. It is important to pay attention to the motor level in both

Table 1. Muscle functions out of key muscle (optional) and related root levels

Motion		Root level
Shoulder:	Flexion, extension, abduction, adduction, internal and external rotation	
Elbow:	Supination	C5
Elbow:	Pronation	
Wrist:	Flexion	C6
Finger:	Flexion in the proximal joint, extension	
Thumb:	Thumb extension and abduction	C7
Finger:	Flexion in the MCP joint	
Thumb:	Opposition, adduction and abduction vertical to the palm	C8
Finger:	Abduction in the second finger	T1
Hip:	Adduction	L2
Hip:	External rotation	L3
Hip:	Extension, abduction, internal rotation	
Knee:	Flexion	
Ankle:	Inversion and eversion	
Finger:	MP and IP extension	L4
Toe and finger:	DIP and PIP flexion and abduction	L5
Toe:	Adduction	S1

Table 2. Classification steps of AIS

1. Determine the sensory levels for the right and left sides.
2. Determine the motor levels for the right and left sides.
3. Determine the level of neurological injury.
4. Determine whether the injury is complete or incomplete.
5. Determine the ASIA Impairment Scale.

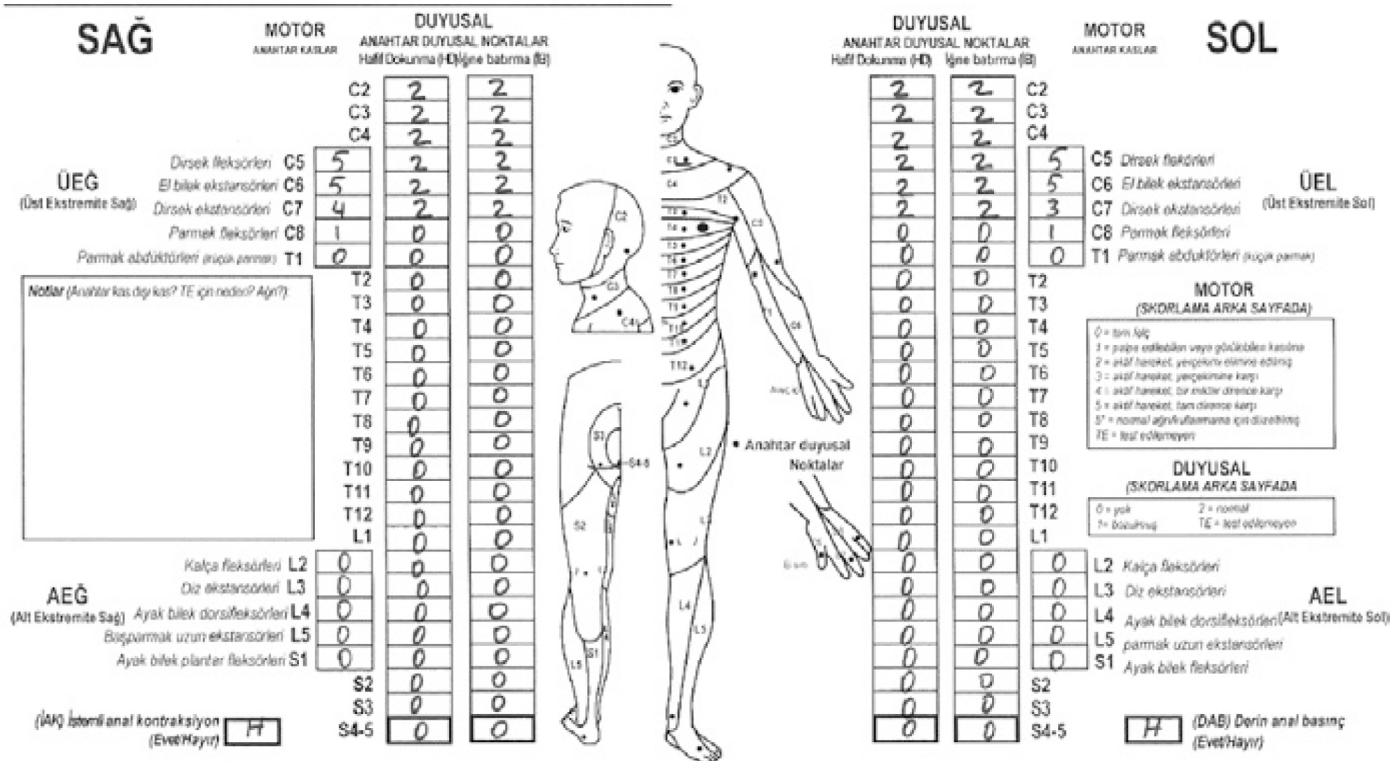


Figure 1. Patient example, Case 1

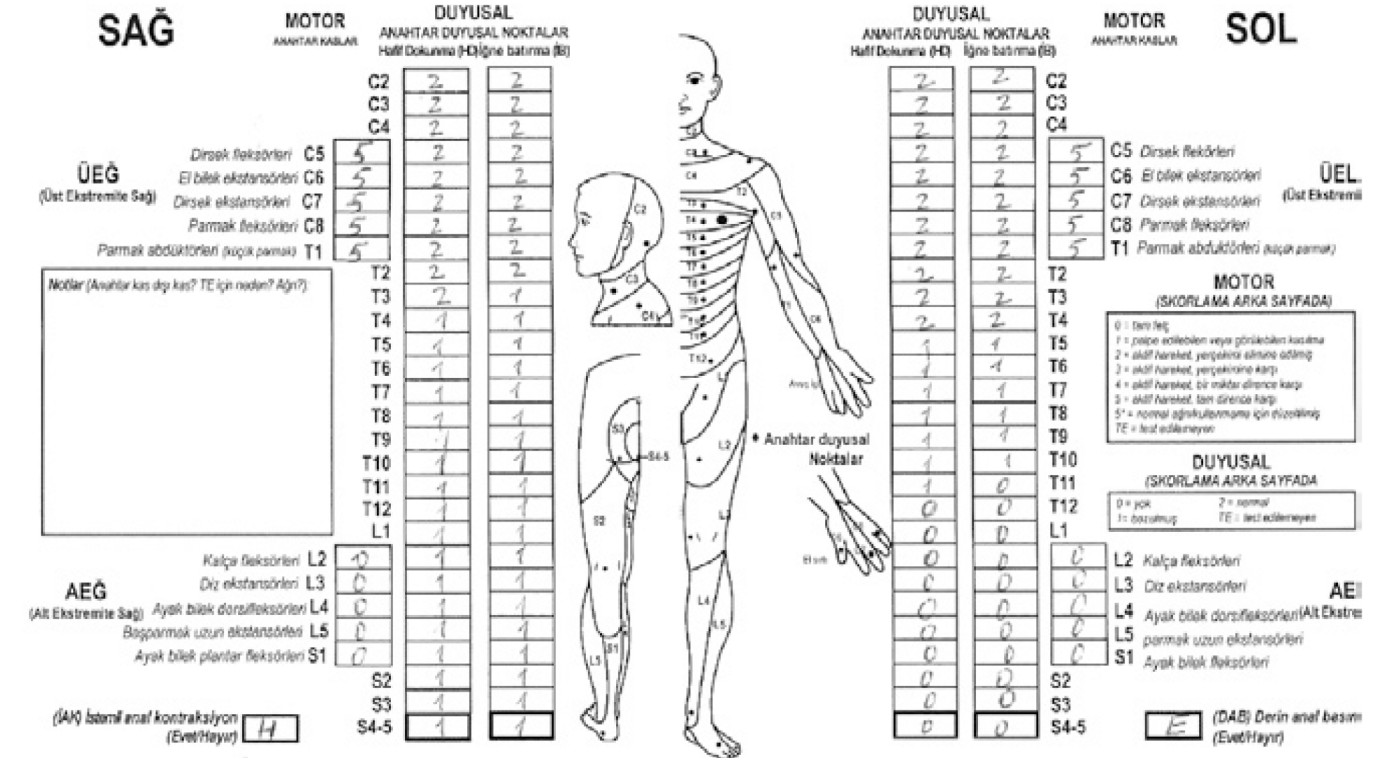


Figure 2. Patient example, Case 2

parts when differentiating AIS B and AIS C; on the other hand, a single neurological level is used to differentiate AIS C and AIS D. Muscles other than key muscles may be used while differentiating AIS B and AIS C, but only key muscles can be used to differentiate AIS C and AIS D.

Finally for the patients with complete injury (AIS A), the partial sparing area (PSA) is defined; partially innervated dermatomes and myotomes under the motor levels are PSA. PSA must be individually recorded for sensory and motor functions for the right and left parts. In case of sparing for more than one area, the most caudal segment is recorded. If no PSA exists below the motor and sensory levels, these levels are recorded on the place reserved for PSA on the examination page (5).

While recording PSA for the motor level, the most sub level muscle level with voluntary contraction is recorded. In places with no motor level, it must be taken into consideration that unlike the defining level, motor PSA cannot be assessed as sensory PSA (5).

In Case 1 (Figure 1), as the patient has complete injury (AIS A) and no spared sensory function exists below the C7/C7 sensory level recorded on the sensory PSA, but as spared motor function exists in the C8 level on both parts, it is recorded as C8/C8 for the motor PSA.

Case 2

In Case 2 (Figure 2), the sensory level is T2/T3. While determining the motor level, as no key muscle exists in this level (T2–L1) and the upper key muscles have normal muscle strength, the motor level is the same as the sensory level (T2/T4). NIL of the patient is T2. Because deep anal pressure and spared sensory function exist on the right S4-5, the sensation of the patient is incomplete. The next step is to determine if the patient is sensory incomplete (AIS B) or motor incomplete (AIS C or AIS D).

Table 3. ASIA Impairment Scale (1,3)

A=Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B=Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) AND no motor function is preserved more than three levels below the motor level on either side of the body.

C=Motor Incomplete. Motor function is preserved below the neurological level**, and more than half of the key muscles functioning below the neurological level of injury (NLI) have a muscle grade less than 3 (Grades 0–2).

D=Motor Incomplete. Motor function is preserved below the neurological level**, and at least half (half or more) of the key muscles functioning below NLI have a muscle grade of >3.

E=Normal. If sensory and motor function as tested with ISNCSCI are graded as normal in all segments and the patient had prior deficits, then the AIS grade is E. A patient without an initial SCI does not receive an AIS grade. .

** For an individual to receive a grade of C or D, i.e., motor incomplete status, they must have either (1) voluntary anal sphincter contraction or (2) sacral sensory sparing with sparing of motor function more than three levels below the motor level for that side of the body. The International Standards at this time allow even non-key muscle function more than 3 levels below the motor level to be used in determining motor incomplete status (AIS B versus AIS C)

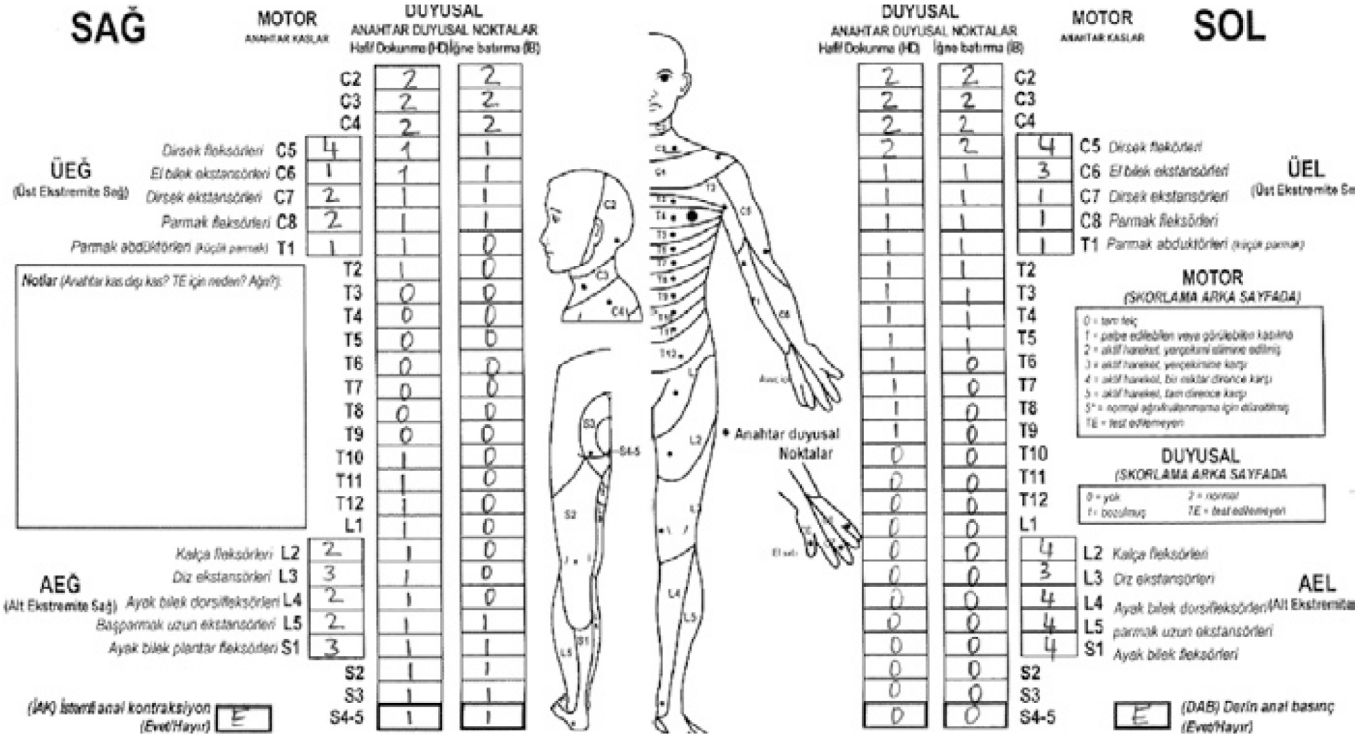


Figure 3. Patient example, Case 3

OMURİLİK YARALANMASI NÖROLOJİK SINIFLAMASI İÇİN ULUSLARARASI STANDARTLAR
(ISNCSCI)

Hasta adı _____ Değerlendirme tarih/saati _____

Değerlendiren _____ İmza _____

SAĞ

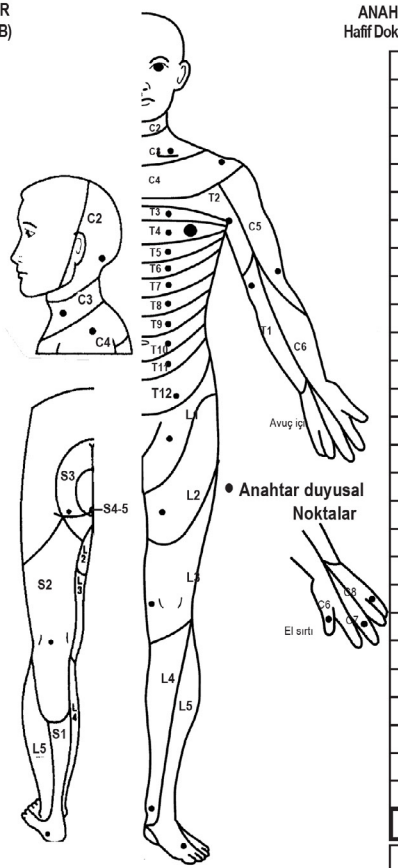
	MOTOR ANAHTAR KASLAR	DUYUSAL ANAHTAR DUYUSAL NOKTALAR Hafif Dokunma (HD)	İğne batırma (İB)
		C2	
		C3	
		C4	
Dirsek fleksörleri	C5		
El bilek ekstansörleri	C6		
Dirsek ekstansörleri	C7		
Parmak fleksörleri	C8		
Parmak abdüktörleri (küçük parmak)	T1		
		T2	
		T3	
		T4	
		T5	
		T6	
		T7	
		T8	
		T9	
		T10	
		T11	
		T12	
		L1	
Kalça fleksörleri	L2		
Diz ekstansörleri	L3		
Ayak bilek dorsifleksörleri	L4		
Başparmak uzun ekstansörleri	L5		
Ayak bilek plantar fleksörleri	S1		
		S2	
		S3	
		S4-5	
SAĞ TOPLAM (MAKSİMUM)		(50)	(56) (56)

ÜEĞ (Üst Ekstremite Sağ)

AEĞ (Alt Ekstremite Sağ)

Notlar *(Anahtar kas dışı kas? TE için neden? Ağrı?):*

(İAK) İstemli anal kontraksiyon (Evet/Hayır) ☐



SOL

DUYUSAL ANAHTAR DUYUSAL NOKTALAR Hafif Dokunma (HD)	İğne batırma (İB)	MOTOR ANAHTAR KASLAR	
		C2	
		C3	
		C4	
		C5	Dirsek flekörleri
		C6	El bilek ekstansörleri
		C7	Dirsek ekstansörleri
		C8	Parmak fleksörleri
		T1	Parmak abduktörleri (küçük parmak)
		T2	
		T3	
		T4	
		T5	
		T6	
		T7	
		T8	
		T9	
		T10	
		T11	
		T12	
		L1	
		L2	Kalça fleksörleri
		L3	Diz ekstansörleri
		L4	Ayak bilek dorsifleksörleri
		L5	Başparmak uzun ekstansörleri
		S1	Ayak bilek fleksörleri
		S2	
		S3	
		S4-5	
(56)	(56)	(50)	SOLTOPLAM (MAKSİMUM)

ÜEL (Üst Ekstremite Sol)

AEL (Alt Ekstremite Sol)

MOTOR *(SKORLAMA ARKA SAYFADA)*

0 = tam felç
1 = palpe edilebilen veya görülebilen kasılma
2 = aktif hareket, yerçekimi elimine edilmiş
3 = aktif hareket, yerçekimine karşı
4 = aktif hareket, bir miktar dirence karşı
5 = aktif hareket, tam dirence karşı
5 = normal ağrı/kullanmama için düzeltilmiş*
TE = test edilemeyen

DUYUSAL *(SKORLAMA ARKA SAYFADA*

0 = yok *2 = normal*
1= bozulmuş *TE = test edilemeyen*

(DAB) Derin anal basınç (Evet/Hayır) ☐

MOTOR ALT SKORLAR

ÜEĞ ☐ + ÜEL ☐ = *ÜEMS TOPLAM* ☐ (MAKS (25) (25) (50))

AEĞ ☐ + AEL ☐ = *AEMS TOPLAM* ☐ (MAKS (25) (25) (50))

DUYUSAL ALTSKORLAR

HDĞ ☐ + HDL ☐ = *HD TOPLAM* ☐ (MAKS (56) (56) (112))

İBĞ ☐ + İBL ☐ = *İB TOPLAM* ☐ (MAKS (56) (56) (112))

NÖROLOJİK SEVİYELER
Sınıflama için 1-5.basamaklar Arka sayfada

	Ğ	L
1. DUYUSAL		
2. MOTOR		

3. NÖROLOJİK YARALANMA SEVİYESİ (NYS) ☐

4. KOMPLET VEYA İNKOMPLET? ☐
İnkomplet: S4-5'te duyusal veya motor fonksiyon

5. ASIA BOZUKLUK SKALASI (ABS) ☐

(Sadece komplet yaralanmalarda)
KISMİ KORUNMA ALANI
Herhangi bir innervasyon olan en alt seviye

	Ğ	L
DUYUSAL		
MOTOR		

Bu form çoğaltılabilir fakat American Spinal Injury Association'ın izni olmadan değiştirilemez.

REV 02/13

Kas Fonksiyonu Derecelendirmesi

0 = tam felç

1 = palpe edilebilen veya görülebilen kasılma

2 = aktif hareket, yerçekimi elimine edildiğinde tam eklem hareket açıklığı (EHA)

3 = aktif hareket, yerçekimine karşı tam EHA

4 = aktif hareket, yerçekimine karşı tam EHA ve kasa özel bir pozisyonda orta derecede direnç

5 = (normal) aktif hareket, yerçekimine karşı tam EHA ve kasın fonksiyonel pozisyonunda sağlıklı bir insandan beklenecek tam direnç

5* = (normal) aktif hareket, yerçekimine karşı tam EHA ve belirlenen inhibe edici faktörler (ağrı, kullanmama) olmasa normal olarak değerlendirilecek yeterli direnç

NT = test edilemeyen (örn. immobilizasyon, hastanın derelendirilmesini engelleyecek şidette ağrı, ekstremite amputasyonu veya eklem hareket açıklığının >%50 kontraktürü nedeniyle)

Duyusal Dereceleme

0 = Yok

1 = Bozulmuş, azalmış/bozulmuş duyu veya hipersensitivite

2 = Normal

TE = Test edilemeyen

Anahtar kas dışı kas fonksiyonları (isteğe bağlı)

ABS B ve C ayrımında motor seviye belirlemek için kullanılabilir

Hareket	Kök Seviyesi
Omuz: Fleksiyon, ekstansiyon, abduksiyon, adduksiyon, iç ve dış rotasyon **Dirsek:** Supinasyon	**C5**
Dirsek: Pronasyon **El bilek:** Fleksiyon	**C6**
Parmak: Proksimal eklemde fleksiyon, ekstansiyon. **Baş parmak:** Baş parmak düzleminde fleksiyon, ekstansiyon ve abduksiyon	**C7**
Parmak: MKF eklemde fleksiyon **Baş parmak:** Oppozisyon, adduksiyon ve avuç içine dik abduksiyon	**C8**
Parmak: İkinci parmakta abduksiyon	**T1**
Kalça: Adduksiyon	**L2**
Kalça: Eksternal rotasyon	**L3**
Kalça: Ekstansiyon, abduksiyon, iç rotasyon **Diz:** Fleksiyon **Ayak bilek:** İnversiyon ve eversiyon **Parmak:** MF and IP ekstansiyon	**L4**
Ayak başparmak ve parmak: DİP ve PİP fleksiyon ve abduksiyon	**L5**
Ayak başparmak: Adduksiyon	**S1**

ASIA Bozukluk Skalası (ABS)

A = Komplet. S4-S5 sakral segmentlerde korunmuş duyusal ve motor fonksiyon yok.

B = Duyusal İnkomplet. Nörolojik seviye altında motor değil, duyusal fonksiyon korunmuştur ve S4-S5 sakral segmentleri de içerir (S4-S5'te hafif dokunma iğne duyusu; veya derin anal basınç DAB)), VE vücut herhangi bir yarısında motor seviyenin üç seviye altında motor fonksiyon korunmamıştır.

C = Motor İnkomplet Nörolojik seviye altında motor fonksiyon korunmuştur**, ve tek nörolojik yaralanma seviyesi (NYS) altındaki anahtar kasların yarısından fazlası 3'ten az (Derece 0-2) kas derecesine sahiptir.

D = Motor İnkomplet. Nörolojik seviye altında motor fonksiyon korunmuştur**, ve NYS altında anahtar kas fonksiyonlarının en az yarısı (yarısı veya fazlası) ≥3 kas derecesine sahiptir.

E = Normal. Önceden defisit mevcut hastalarda ISNCSCI ile değerlendirilen duyu ve motor fonksiyon tüm segmentlerde normal olarak değerlendirilir ise ABS derecesi E'dir. Başlangıçta OY olmayan kişi bir ABS derecesi almaz.

** Bir kişinin C veya D dercesi alması, yani motor inkomplet olması için, ya(1) istemli anal sfinkter kasılması veya (2) vücut o tarafında motor seviyenin 3 seviyeden fazla altında motor fonksiyon korunması ile birlikte sakral duyusal korunma olmalıdır. Bu Uluslararası Standartlar bugün için motor inkomplet durumun belirlenmesinde (ABS B veya C) motor seviyenin 3 seviyeden fazla altında anahtar kas dışında kas fonksiyonunun kullanımına izin verir.

NOT: ABS B ve C arasında ayrım yapmak için seviye altında motor fonksiyon değerlendirilmesinde her iki taraftaki *motor seviye* kullanılır; ABS C ve D ayrımında ise (gücün derece 3 ve üzerinde olduğu anahtar kas fonksiyonu oranına dayanarak) *nörolojik yaralanma seviyesi* kullanılır.

ASIA
AMERICAN SPINAL INJURY ASSOCIATION

OMURİLİK YARALANMASI NÖROLOJİK SINIFLAMASI İÇİN ULUSLARARASI STANDARTLAR

ISCOS
INTERNATIONAL SPINAL CORD SOCIETY

Sınıflandırma Basamakları

OY'li bireylerin sınıflamasını belirlemede aşağıdaki sıralama önerilmektedir.

1. **Sağ ve sol taraf için duyu seviyelerini belirle.**
Duyusal seviye hem iğne hem hafif dokunma duyusu için normal olan en kauda sağlam dermatomdur.

2. Sağ ve sol taraf için motor seviyelerini belirle.
Üzerinde seviyelerde temsil edilen anahtar kas fonksiyonları sağlam olarak (5 olarak derecelendirilmiş) değerlendirilmiş olmak koşulu ile, en az 3 derecesindeki (supin pozisyonda) en alt anahtar kas fonksiyonu olarak tanımlanır.
Not: değerlendirilecek miyotom olmayan bölgelerde, eğer bu seviye üzerinde değerlendirilebilen motor seviye de normal ise motor seviye duyusal seviye ile aynı kabul edilir.

3. Nörolojik yaralanma seviyesini (NYS) belirle.
Üzerindeki motor ve duyusal fonksiyon normal (intakt) olmak koşulu ile kordun intakt duyu ve antigravite (3 veya üzeri) kas fonksiyon kuvveti olan en kaudal segmentini tanımlar.
NYS 1. ve 2. basamaklarda saptanmış duyusal ve motor seviyelerin en sefalad (başa yakın) olanıdır.

4. Yaralanmanın Komplet veya İnkomplet olduğunu belirle.
(sakral korunmanın olması veya olmaması)
*Eğer istemli anal kasılma = **Hayır** VE tüm S4-5 duyusal skorlar = **0** VE derin anal basınç = **Hayır** ise yaralanma **Komplet**.*
*Bunun dışında, yaralanma **İnkomplettir**.*

5. ASIA Bozukluk Skala (ABS) Derecesini belirle:

Yaralanma Komplet mi? Eğer EVET ise, ABS=A

HAYIR ↓ KKA (her iki tarafta biraz korunma olan en alt dermatom veya myotom)

Yaralanma Motor Komplet mi? EVET ise, ABS=B

HAYIR ↓ (Hayır= hasta duyusal inkomplet sınıflamada ise belirlenen taraf için motor seviyenin üç seviyeden fazla aşağısında motor fonksiyon VEYA istemli anal kasılma)

Nörolojik yaralanma seviyesi altındaki anahtar kasların en yarısı derece 3 veya üzerinde mi?

HAYIR ↓ **ABS=C** **EVET** ↓ **ABS=D**

Eğer tüm segmentlerde duyu ve motor fonksiyon normal ise, ABS=E
Not: ABS E OY kanıtlanmış bir kişi normal fonksiyona iyileştiğinde kullanılır. Eğer başlangıç değerlendirmesinde defisit yoksa kişi nörolojik olarak intakttır; ASIA Bozukluk Skalası uygulanmaz.

Because there is no voluntary anal contraction or spared motor function three levels (T2/T4) further than the motor level, the patient is sensory incomplete. The patient is defined as T2 AIS B.

Case 3

In Case 3 (Figure 3), the sensory level is the most rostral level (C4/C5) with a sensory degree of 2. Both C5 myotomes have 4/5 muscle strength degree function; due to the absence of muscle on the C4 dermatome, a score of 2 is considered to be normal.

The motor level is defined as C5/C5. NIL of the patient is C4. The patient is incompletely injured; spared sense, deep anal pressure, and voluntary anal contraction exist. The patient is incompletely injured (AIS C or AIS D) because voluntary anal contraction and spared motor function three levels further than the motor level exist; even one of these is sufficient to classify the patient as incompletely injured.

For AIS C and AIS D differentiation, we check the strength of the key muscles under NIL. When NIL is C4, there are 20 key muscles under this level. Because 10 of them have three or more muscle powers, we define the patient as C4 AIS D.

ISNCSCI is revised, and explanations are added by the International Standards committee as a result of questions and patient outcomes. The most contemporary standards may not be the most ideal system; however, it is accepted that a common language has been established (1,6). The committee shares information on difficult cases (1); healthcare professionals in the field of spinal cord injuries are advised to follow the publications and the changes that may occur in the standards.

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Conflict of Interest: No conflict of interest was declared by the author.

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