The American Spinal Injury Association Impairment Scale (AIS): International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI)

Assessment Overview

Assessment Area

ICF Domain:
Body Function
Subcategory:
Neuromusculoskeletal & Movement-related Functions and Structures

You Will Need

Length:
AIS: approx. 10-15 minutes
ISNCSCI: approx. 30-60 minutes
- Pin Prick: 56 locations
- Light Touch: 56 locations
- Upper Motor: 10 locations
- Lower Motor: 10 locations

Scoring:
The AIS is scored on a 5 point ordinal scale from A (sensory & motor complete SCI) to E (normal sensory and motor function).
On the ISNCSCI, Sensory scores rated 0 (sensation absent), 1 (impaired) and 2 (normal) for each dermatome. Light Touch & Pin Prick each scored out of 112 (28 locations bilaterally with a max score of 2 at each location).
Muscle function rated 0 (total paralysis) to 5 (active movement, full ROM against significant resistance) for each myotome. UEMS & LEMS each scored out of 50; ASIA Motor Score scored out of 100.
The presence of anal sensation and voluntary anal contraction are assessed as a yes/no.
Results can be entered into www.isncscialgorithm.com to calculate the key scores for neurological classification.
Training:
Training is mandatory. The International Standards Training e-Learning Program (InSTeP) is a

Summary

The **ASIA (American Spinal Injury Association) Impairment Scale (AIS)**, based on the Frankel scale, is a clinician-administered scale used to classify the severity (completeness) of injury in individuals with SCI. It identifies sensory and motor levels indicative of the highest spinal level demonstrating "unimpaired" function. Preservation of function in the sacral segments (S4-S5) is key for determining the AIS grade. AIS scores are considered essential when classifying persons with SCI to determine their neurological status.

The International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) is a comprehensive clinician-administered neurological exam for SCI. It is widely used for research and clinical (neurologic) description for to fully assess sensory and motor functioning and level of injury in traumatic and non-traumatic SCI. From the ISNCSCI, several measures of neurological damage can be determined, such as: Sensory and Motor Levels (on right and left sides), Neurological Level of Injury (NLI), Sensory Scores (Pin Prick and Light touch Score), Motor Scores (Upper Extremity and Lower Extremity Motor Score (UEMS & LEMS), combined to give Motor Score), and Zone of Partial Preservation. The entire examination is conducted by testing and scoring 28 key points (dermatomes) for Sensory and 10 key paired-points (myotomes) for Motor.

The ISNCSCI exam should be performed in the supine position (except for the rectal examination that can be performed side-lying) to ensure scores collected are standard and comparable.

The exam is generally well tolerated although sensory testing for those with severe hypersensitivity may be uncomfortable and testing for anal sensation/voluntary contraction can result in the stimulation of a bowel movement.

The test may pose a significant clinician/patient burden unless the clinician is experienced and is familiar with the test.

Certain circumstances may require the more rapid expedited ISNCSCI (E-ISNCSCI) which has been developed to determine the NLI and the AIS with the minimum number of steps using the standard ISNCSCI testing procedures. Currently, a more in-depth "Research Options" ISNCSCI (RO-ISNCSCI) is being developed to assist researchers in characterising persons with SCI. Both E-ISNCSI and RO-ISNCSCI are designed to be compatible with the standard ISNCSCI exam. More information can be found here.

The ISNCSCI is currently on its 8th edition, updated in 2019 to include documentation of non-SCI-related impairments, updated definition of the zone of partial preservation, revised worksheet, and patterns of incomplete injury.

five-module course (including basic anatomy, sensory examination, motor examination, anorectal examination, and scoring, scaling, and the AIS classification) designed to enable clinicians to perform accurate and consistent SCI neurological examinations of individuals with SCI.
The test may pose a significant clinician/patient burden and results may be inaccurate unless the clinician is experienced and well-practiced in the test.

Equipment:

- Safety pin
- A tapered wisp of cotton (from a cotton swab or Q tip)

Availability

Motor Exam Guide from: http://asia-spinalinjury.org/wp-content/uploads/2016/02/Motor_Exam_Guide.pdf

Sensory Exam Guide from: http://asia-spinalinjury.org/wp-content/uploads/2016/02/Key_Sensory_Points.pdf

Scoring Diagram and Worksheet: https://asia-spinalinjury.org/wp-content/uploads/2023/12/ASIA-ISCOS-Worksheet-Sides-12_12_4_2023.pdf

Online ISNCSCI calculator: www.isncscialgorithm.com

Video: https://www.youtube.com/watch?v=PpgGzIhCpuI

Languages: ISNCSCI Worksheet is available in many languages: https://asia-spinalinjury.org/isncsci-worksheet-now-available-in-other-languages/

Assessment Interpretability

Minimal Clinically Important Difference

Total Motor Score: 4.48
Total Sensory Score: 5.19
UEMS: 2.72
LEMS: 3.66

(Scivoletto et al. 2013; n=661; 440 males; mean age: 50.35 years; 233 ASIA A, 67 ASIA B, 158 ASIA C, 142 ASIA D; mean (SD) time since injury = 51.6(36.8) days)

Statistical Error

Minimal Detectable Change:
Total Motor Score: 1.87
Total Sensory Score: 3.87

Standard Error of Measurement:
Total Motor Score = 0.67
Total Sensory Score = 1.40

(Scivoletto et al. 2013; n=661, 478 males; mixed injury types; mean (SD) time since injury = 51.6(36.8) days)

Typical Values

Mean (SD) Scores:
Motor Score at 1 year post-injury: 45.2 (22.8)
Motor Score at 5 years post-injury: 46.6 (23.3)

(Kirshblum et al. 2004; n=559 from Model SCI Systems Database; traumatic SCI; reported in Furlan et al. 2008)

Median (IQR) Scores:
Motor Score at discharge: 50 (31-70)
UEMS at discharge: 44 (23-50)
LEMS at discharge: 0 (0-30)

(Marino & Graves 2004; n=4338, 3443 males; 854 complete tetraplegia, 1464 incomplete tetraplegia, 1195 complete paraplegia, 825 incomplete paraplegia, 2049 ASIA A, 511 ASIA B, 655 ASIA C, 1123 ASIA D; median (IQR) time since injury = 15 (9-28) days)

Measurement Properties

Validity – Moderate to High

High correlation with Quadriplegia Index of Function:
Motor Score= 0.91
Light Touch Score = 0.64
Pin Prick Score = 0.65

Moderate to High correlation with Functional Independence Measure (FIM):
Motor Score = 0.91
Light Touch Score = 0.58
Pin Prick Score = 0.55

(Yavuz et al. 1998; n=29; 20 males; mean age: 37 years; tetraplegia; mean (range) time since injury: 20 (2-72) weeks)

High correlation with 6 Minute Walk Test (6MWT):
Motor Score = 0.64
LEMS = 0.70

High correlation with 10 Meter Walk Test (10MWT):
Motor Score = 0.63
LEMS = 0.69

Moderate to High correlation with Berg Balance Scale
Motor Score = 0.75
LEMS = 0.79

(Harkema et al. 2016; n=152; 123 male; mean age: 36 years; 43 ASIA A, 21 ASIA B, 39 ASIA C, 49 ASIA D; median (range) time post-SCI: 0.9 (0.1-45.2) years)

Moderate correlation with Walking Index for SCI:
LEMS = 0.58

(Morganti et al. 2005; n=200; 184 males; mean age: 50.4 years; 84 ASIA A, 19 ASIA B, 129 ASIA C, 52 ASIA D; mean (SD) time since injury: 56.9(43.9) days)

Number of studies reporting validity data: 26

Reliability – High

High Inter-rater Reliability:
Motor Score: ICC = 0.999
Light Touch Score: ICC = 0.997
Pin Prick Score: ICC = 0.988

(Savic et al. 2007; n=45; 38 males; mean age: 40.3 years; 24 ASIA A, 4 ASIA B, 4 ASIA C, 13 ASIA D; 3 months to 43 years post-SCI)

High Intra-rater Reliability:
UEMS: ICC = 0.98
Light Touch Score: ICC = 0.99
Pin Prick Score: ICC = 0.99

(Marino et al. 2008; n=16; 16 examiners; 10 males; 5 complete tetraplegia, 5 motor incomplete tetraplegia, 5 complete paraplegia, 1 motor incomplete paraplegia)

Number of studies reporting reliability data: 5

Responsiveness

Floor/Ceiling Effect:
UEMS:
42% of subjects at ceiling (score 50)

LEMS:
53% of subjects at floor (score 0)

(Marino & Graves 2004; n=4338, 3443 males; 854 complete tetraplegia, 1464 incomplete tetraplegia, 1195 complete paraplegia, 825 incomplete paraplegia, 2049 ASIA A, 511 ASIA B, 655 ASIA C, 1123 ASIA D; median (IQR) time since injury = 15 (9-28) days)

Effect Size:
UEMS: 0.69-1.29
Light Touch Score: -0.08-0.30

(Velstra et al. 2015; n=74; 51 males; mean age: 49 years; at one month: 18 ASIA A, 12 ASIA B, 10 ASIA C, 34 ASIA D; acute SCI at study enrollment, measured 1,3,6,12 months post-SCI)

Standardized Response Mean:
Motor Score: 0.33
UEMS: 0.38
LEMS: 0.23

(Post locomotor training; breakdown by AIS levels available in research summary; Harkema et al. 2016; n=152; 123 male; mean age: 36 years; 43 ASIA A, 21 ASIA B, 39 ASIA C, 49 ASIA D; median (range) time post-SCI: 0.9 (0.1-45.2) years)

Number of studies reporting responsiveness data: 5