



SPINAL CORD INJURY ASSESSMENT SCALES

A Clinical Guide with Case Studies for Physiotherapy Students

ISNCSCI / ASIA • AIS • GRASSP • SCIM III • WISCI II • SCI-QOL

From Neurological Diagnosis to Functional Recovery & Quality of Life

PHYSIOCITY



TABLE OF CONTENTS

Ch.	Topic	Pg
1	Introduction to Spinal Cord Injury	3
2	The SCI Assessment Journey — Overview	4
3	ISNCSCI / ASIA Examination — In Detail	5
4	AIS Grading (A–E) Explained	8
5	SCI Syndromes — Quick Reference	10
6	GRASSP — Hand Function Assessment	12
7	SCIM III — Independence Measure	14
8	WISCI II — Walking Index	16
9	SCI-QOL — Quality of Life	18
10	Supplementary Scales (MAS, BBS, 10MWT, 6MWT)	19
11	Decision Flowchart — Which Scale To Use	21
12	CASE STUDY 1 — Cervical SCI (C6 Incomplete, AIS C)	22
13	CASE STUDY 2 — Complete Thoracic SCI (T10, AIS A)	27
14	Comparison of Case 1 vs Case 2	29
15	One-Line Exam Revision Table	30



CHAPTER 1

Introduction to Spinal Cord Injury

1.1 What is Spinal Cord Injury?

Spinal Cord Injury (SCI) is damage to the spinal cord that results in loss of motor, sensory, and/or autonomic function below the level of the lesion. It may be **traumatic** (RTA, falls, sports, violence) or **non-traumatic** (tumor, infection, vascular, degenerative).

- Tetraplegia (quadriplegia): Injury in cervical segments — affects all 4 limbs + trunk
- Paraplegia: Injury in thoracic, lumbar, or sacral segments — affects trunk/legs only
- Complete injury: No motor/sensory function preserved in lowest sacral segments (S4-S5)
- Incomplete injury: Some function preserved below the level, including S4-S5

1.2 Why Do We Need Multiple Scales?

No single scale captures the full picture of SCI. Each tool measures a different dimension of the patient's condition — from the cellular/neurological level all the way to social participation and quality of life. Using them together gives a complete clinical and functional picture.

The Big Picture

- Neurological impairment → measured by ISNCSCI/ASIA & AIS
- Body-region specific function (hands) → measured by GRASSP
- Activities of daily living / independence → measured by SCIM III
- Walking ability → measured by WISCI II (and 10MWT/6MWT)
- Tone/spasticity → measured by MAS
- Balance → measured by Berg Balance Scale
- Psychosocial wellbeing & participation → measured by SCI-QOL



CHAPTER 2

The SCI Assessment Journey — Overview

2.1 Patient Journey Concept

The best way to remember these scales is to follow ONE patient from the moment of admission through to community reintegration. Each scale answers a different question at a different stage of recovery.

Stage	Question Being Asked	Scale Used
Admission (Day 1)	"What is the neurological level and severity?"	ISNCSCI / ASIA → AIS Grade
Early rehab (Week 1-2)	"Can the patient use their hands?" (if cervical)	GRASSP
Rehab phase (Week 2 onward)	"How independent is the patient in daily activities?"	SCIM III
Mobility phase	"Can the patient walk, and how much help is needed?"	WISCI II
Ongoing / discharge	"How is the patient coping psychologically and socially?"	SCI-QOL

2.2 The Sequence to Remember

ASIA → AIS → GRASSP → SCIM → WISCI → SCI-QOL

This sequence follows the patient's journey: **Neurological diagnosis** → **Region-specific function** → **Functional independence** → **Ambulation** → **Participation & quality of life**.



CHAPTER 3

ISNCSCI / ASIA Examination — In Detail

3.1 What Is It?

The International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI), maintained by ASIA (American Spinal Injury Association), is the gold-standard examination used to determine the neurological level and severity of SCI.

3.2 Components of the Examination

Component	What Is Tested	Scoring
Motor examination	10 key muscles each side (5 upper limb C5-T1, 5 lower limb L2-S1)	0-5 MRC scale per muscle; max 100 (50 UE + 50 LE)
Sensory examination	Light touch + pin prick at 28 dermatomes each side (C2-S4/5)	0=absent, 1=impaired, 2=normal; max 112 each side per modality
Anorectal examination	Voluntary anal contraction (VAC) + deep anal pressure (DAP)	Present/Absent — determines completeness

3.3 Key Muscles Tested (Motor Level)

Upper Limb	Muscle	Lower Limb	Muscle
C5	Elbow flexors (biceps)	L2	Hip flexors (iliopsoas)
C6	Wrist extensors	L3	Knee extensors (quadriceps)
C7	Elbow extensors (triceps)	L4	Ankle dorsiflexors (tibialis anterior)
C8	Finger flexors (FDP to middle finger)	L5	Long toe extensors (EHL)
T1	Finger abductors (ADM)	S1	Ankle plantarflexors (gastroc/soleus)

3.4 Key Definitions

- **Neurological Level of Injury (NLI):** Most caudal segment with normal motor (grade ≥ 3 , with normal segment above) AND normal sensory function on BOTH sides
- **Sensory Level:** Most caudal dermatome with normal sensation (pin prick + light touch)
- **Motor Level:** Most caudal key muscle with grade ≥ 3 , provided muscles above are grade 5
- **Zone of Partial Preservation (ZPP):** Dermatomes/myotomes caudal to level showing some preservation — used ONLY in complete (AIS A) injuries
- **Sacral Sparing:** Presence of any of: voluntary anal contraction, deep anal pressure sensation, S4-S5 light touch/pin prick, or perianal sensation — determines COMPLETE vs INCOMPLETE

■ **MEMORY TRICK:** Sacral sparing present = injury is **INCOMPLETE**, no matter how weak the limbs are!



CHAPTER 4

AIS Grading (A–E) Explained

4.1 The Five AIS Grades

Grade	Definition	Memory Trick
A — Complete	No motor or sensory function in S4-S5 segments (no sacral sparing)	"Absolutely complete"
B — Sensory Incomplete	Sensory but NOT motor function preserved below level, including S4-S5	"Barely sensing"
C — Motor Incomplete	Motor function preserved below level; MORE THAN HALF of key muscles below the level have grade <3	"Can move, but weak"
D — Motor Incomplete	Motor function preserved below level; AT LEAST HALF of key muscles below the level have grade ≥3	"Doing well, mostly antigravity"
E — Normal	Sensation and motor function normal in all segments, with prior deficit documented	"Excellent / Everything normal"

4.2 Step-by-Step AIS Decision Process

- Step 1: Is there ANY sacral sparing (VAC, DAP, S4-5 sensation)? → If NO = Grade A
- Step 2: If sacral sparing present, is there motor function more than 3 levels below the motor level? → If NO (sensory only) = Grade B
- Step 3: If motor function present below level, what fraction of key muscles below the SINGLE NEUROLOGICAL LEVEL score ≥3?
 - → If LESS than half (50%) score ≥3 = Grade C
 - → If HALF or MORE score ≥3 = Grade D
- Step 4: If sensation and motor are entirely normal (with a documented prior deficit) = Grade E

4.3 Worked Example (from Case Study 1)

Patient has C6 neurological level. Below this level (C7, C8, T1 and all lower limb myotomes): C7 Triceps=2, C8 Finger Flexor=1, T1 Finger Abductor=1, L2=2, L3=2, L4=1, L5=1, S1=1. **Sacral sensation is present** (sacral sparing = incomplete injury). Looking at the key muscles below the level — ALL score below 3 (none reach grade 3 or above). Since fewer than half (in this case, none) of the muscles below the level have grade ≥3 → **AIS C**.



CHAPTER 5

SCI Syndromes — Quick Reference

Syndrome	Features	Cause/Notes
Central Cord Syndrome	Arm weakness > leg weakness; variable sensory/bladder changes	Most common; hyperextension in elderly with spondylosis
Anterior Cord Syndrome	Motor + pain/temp loss; proprioception PRESERVED	Worst prognosis among incomplete syndromes
Brown-Séquard Syndrome	Ipsilateral motor + proprioception loss; contralateral pain/temp loss	Hemisecction; BEST prognosis among incomplete syndromes
Posterior Cord Syndrome	Loss of proprioception/vibration; motor relatively preserved	Rare; sensory ataxia
Cauda Equina Syndrome	Pure LMN pattern; saddle anaesthesia; flaccid bladder/bowel	Below L1-L2; surgical emergency
Conus Medullaris Syndrome	Mixed UMN+LMN signs; bladder/bowel dysfunction	At L1-L2 level



CHAPTER 6

GRASSP — Hand Function Assessment

6.1 What Does GRASSP Stand For?

Graded **R**edefined **A**ssessment of **S**trength, **S**ensibility and **P**rehension. Designed specifically for **cervical SCI (tetraplegia)** where hand function is the primary functional concern.

■ **MEMORY TRICK: GRASSP = GRASP function. Used ONLY when the lesion is cervical and hands are affected.**

6.2 Components of GRASSP

Domain	What Is Assessed	Scoring
Strength	10 muscles per arm (5 already in ISNCSCI + 5 additional hand muscles)	0-5 MRC per muscle; max 50/arm
Sensibility	Dorsal and palmar surface of hand at 3 sites	0-2 per site (semmes-weinstein/pin prick); max 12/hand
Prehension (Qualitative)	Ability to perform grasp patterns (cylindrical, lateral, etc.)	0-2 per pattern; max 10/hand
Prehension (Quantitative)	Time taken to complete functional tasks (pick up coin, pour water, etc.)	Pass/fail timed tasks; max 12/hand

6.3 Clinical Application (Case Study 1)

In Case Study 1, the patient could hold a bottle (gross grasp present), found buttoning a shirt difficult (fine motor/pinch impaired), and could NOT pick up a coin (precision pinch absent). This pattern of **low hand function score** on GRASSP directly guides hand-specific rehabilitation — e.g., tenodesis grasp training, splinting, adaptive equipment.



CHAPTER 7

SCIM III — Independence Measure

7.1 What Does SCIM Stand For?

Spinal Cord Independence Measure (Version III). It assesses functional independence specifically designed for the SCI population — more sensitive to SCI-specific changes than generic scales like the Barthel Index or FIM.

■ **MEMORY TRICK:** SCIM = SCI Independence Measure — focuses on what the patient can do for themselves.

7.2 The Three Subscales

Subscale	Items Included	Max Score
Self-Care	Feeding, bathing (upper/lower body), dressing (upper/lower body), grooming	20
Respiration & Sphincter Management	Respiration, bladder management, bowel management, use of toilet	40
Mobility	Bed mobility, transfers (bed-wheelchair, wheelchair-toilet/tub), indoor/outdoor mobility, stairs	40

Total SCIM III score range: 0-100 — higher score = greater independence.

7.3 Clinical Application (Case Study 1)

Domain	Finding
Self-care	Eating = partial assistance required
Respiration	Independent (no ventilatory support needed)
Mobility	Needs wheelchair for mobility
Initial SCIM III score	38 / 100
SCIM III score after 6 months	75 / 100

The improvement from 38 to 75 demonstrates measurable, quantifiable progress with rehabilitation — SCIM is excellent for tracking longitudinal recovery and justifying continued therapy or discharge planning.



CHAPTER 8

WISCI II — Walking Index for Spinal Cord Injury

8.1 What Does WISCI Stand For?

Walking Index for Spinal Cord Injury (Version II). A 21-level ordinal scale (0-20) that captures the amount of physical assistance, bracing, and assistive devices required for the patient to walk 10 meters.

■ **MEMORY TRICK:** Higher WISCI score = LESS assistance needed = better walking function.

8.2 Scale Structure (Selected Levels)

Score	Level of Assistance
0	Unable to stand and walk
4	Walks with parallel bars, braces, and physical assistance of 2 people
8	Walks with walker/crutches, braces, and assistance of 1 person
12	Walks with cane/crutch, braces, no physical assistance
15	Walks with cane, no braces, no physical assistance
19	Walks without devices, braces, or assistance — but with mild limitation
20	Walks without devices, braces, or assistance — completely normal

8.3 Clinical Application (Case Study 1)

Timepoint	Walking Status	WISCI II Score
Initial assessment	Parallel bars + therapist assistance	4
After 6 months	Walking with cane	15

The jump from score 4 to 15 reflects a major functional milestone: from needing parallel bars and a therapist, to independently walking with only a cane — a powerful way to communicate rehabilitation outcomes to the patient and care team.



CHAPTER 9

SCI-QOL — Quality of Life

9.1 What Is SCI-QOL?

A patient-reported outcome measure (PROM) developed using item-response theory, specifically calibrated for the SCI population. It captures domains that purely physical scales cannot — psychosocial wellbeing, participation, and emotional adaptation.

9.2 Domains Assessed

Domain Category	Examples of Items
Physical	Pain interference, fatigue, sleep disturbance, bladder/bowel management difficulty
Emotional	Depression, anxiety, fear of dependency, grief/loss, positive affect & wellbeing
Social	Social participation, satisfaction with social roles, independence

9.3 Clinical Application — Compare Both Cases

Case	SCI-QOL Findings
Case 1 (C6, AIS C, 28M)	Reports anxiety, poor social participation, fear of dependency
Case 2 (T10, AIS A, 35F)	Good emotional adaptation despite complete paralysis

This highlights a CRITICAL teaching point: **injury severity (AIS grade) does NOT predict psychological adjustment.** The patient with the more severe injury (Case 2, AIS A) shows better emotional adaptation than the patient with the less severe injury (Case 1, AIS C) — underscoring why SCI-QOL is an essential, independent assessment that cannot be inferred from neurological or functional scores alone.



CHAPTER 10

Supplementary Scales

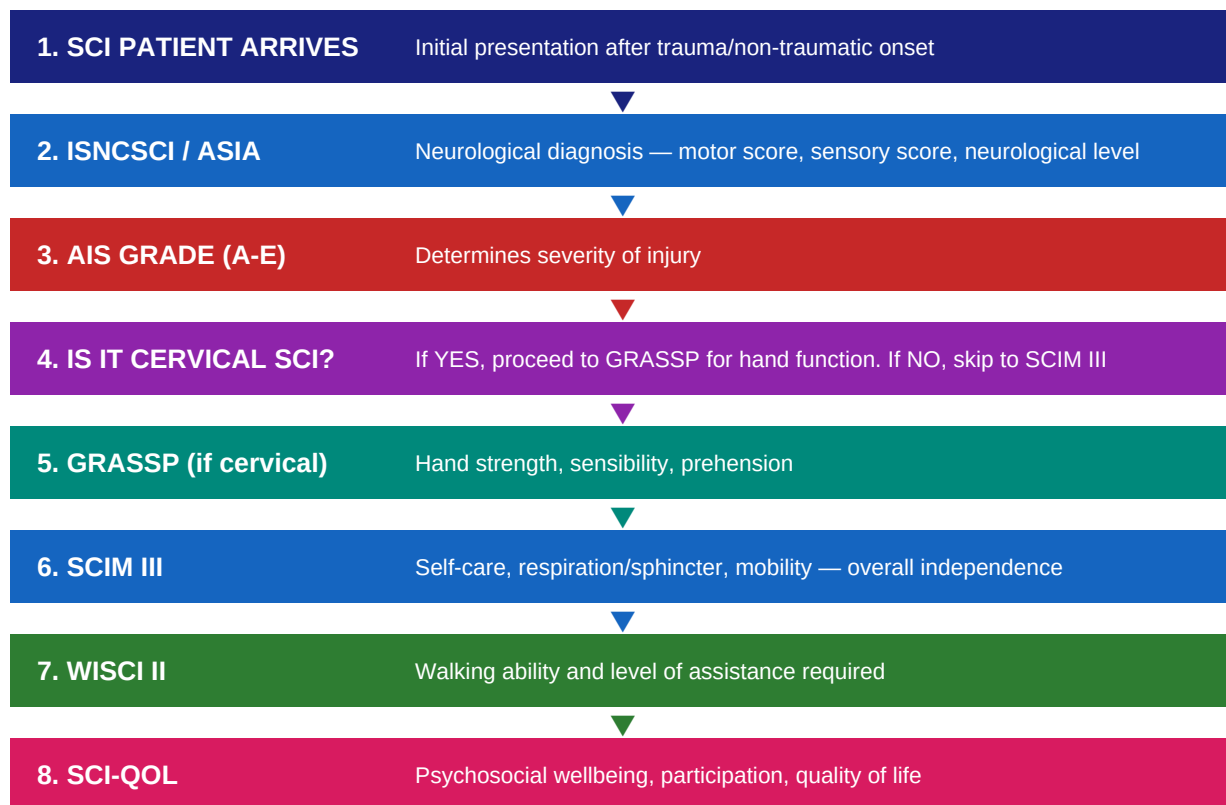
Scale	Full Name	What It Measures	Scoring
MAS	Modified Ashworth Scale	Spasticity / muscle tone	0 to 4 grades
BBS	Berg Balance Scale	Balance (14 functional tasks)	0-56; <45 = fall risk
10MWT	10-Meter Walk Test	Walking speed (m/s)	Timed; self-selected/fast pace
6MWT	6-Minute Walk Test	Walking endurance/distance	Total meters in 6 minutes

These scales are typically used **alongside** WISCI II once the patient begins to ambulate, to give a fuller picture of quality, speed, and endurance of walking — not just the level of assistance required.



CHAPTER 11

Decision Flowchart — Which Scale To Use





CHAPTER 12

Case Study 1 — Cervical SCI (C6 Incomplete)



PATIENT PROFILE

- 28-year-old male
- Mechanism: Road traffic accident
- Level: C6 spinal cord injury
- Presentation: Weakness in all four limbs (tetraparesis)
- Sensory: Can feel light touch around the anus (sacral sensation present)
- Motor: Some voluntary leg movement noted

STEP 1: ISNCSCI / ASIA Assessment

Motor Examination — Upper & Lower Limb

Muscle (Myotome)	MRC Score
C5 — Biceps	5
C6 — Wrist Extensor	4
C7 — Triceps	2
C8 — Finger Flexor	1
T1 — Finger Abductor	1

Muscle (Myotome)	MRC Score
L2 — Hip Flexors	2
L3 — Knee Extensors	2
L4 — Ankle Dorsiflexors	1
L5 — Long Toe Extensors	1
S1 — Ankle Plantarflexors	1

Sensory: Light touch preserved; pin prick impaired; sacral sensation present.

Classification

- Neurological level of injury = C6 (last fully intact level)
- Sacral sparing IS present, so the injury is INCOMPLETE
- Key muscles below the neurological level are ALL scoring less than 3
- Conclusion: AIS C

■ **MEMORY TRICK:** AIS C = "Can move but weak" — motor incomplete, less than half of key muscles below level reach grade 3.

STEP 2: GRASSP Assessment

Rationale: Cervical SCI directly affects hand function, so GRASSP is indicated.

Functional Task	Ability
Hold a bottle (gross grasp)	Yes
Button a shirt (fine motor/pinch)	Difficult
Pick up a coin (precision pinch)	No

Result: Low hand function score — guides hand-specific interventions such as tenodesis grasp training, adaptive splinting, and assistive devices.

■ **MEMORY TRICK:** GRASSP = "Grasp" function — used because cervical SCI affects the hands.

STEP 3: SCIM III Assessment

Subscale	Finding
Self-care (Eating)	Partial assistance required
Respiration	Independent
Mobility	Needs wheelchair
Initial SCIM III Score	38 / 100
SCIM III Score (after 6 months)	75 / 100

The improvement from 38 to 75 demonstrates clear rehabilitation progress in overall functional independence over 6 months.

■ **MEMORY TRICK:** SCIM = SCI Independence Measure.

STEP 4: WISCI II Assessment

Timepoint	Walking Status	Score
Initial	Parallel bars + therapist assistance	4
After 6 months	Walking with cane	15

■ **MEMORY TRICK:** Higher WISCI score = Less assistance required.

STEP 5: SCI-QOL Assessment

Domain	Patient-Reported Finding
Emotional	Anxiety
Social	Poor social participation
Psychological	Fear of dependency

SCI-QOL identifies important psychosocial issues that physical scales (SCIM, WISCI) cannot capture — these findings should trigger referral to psychology/counselling services as part of holistic SCI rehabilitation.

Summary — Case 1 Trajectory

Scale	Initial	After 6 Months	Interpretation
AIS Grade	C	C (or improved to D)	Motor incomplete; potential for further improvement
SCIM III	38/100	75/100	Marked gain in independence
WISCI II	4	15	Major improvement: bars+assist to cane, independent
SCI-QOL	Anxiety, fear of dependency	(monitor over time)	Needs psychosocial support throughout



CHAPTER 13

Case Study 2 — Complete Thoracic SCI (T10)



PATIENT PROFILE

- 35-year-old female
- Mechanism: Fall injury
- Level: T10 lesion
- Presentation: No movement below the lesion
- Sensory: No sensation in S4-S5 segments

STEP 1: ISNCSCI / ASIA Assessment

Classification

- Neurological level of injury = T10
- No motor function below the level
- No sensation, including S4-S5 (no sacral sparing)
- Conclusion: AIS A

■ **MEMORY TRICK: AIS A = "Absolutely complete" — no motor or sensory function in the lowest sacral segments.**

STEP 2: SCIM III Assessment

Domain	Finding
Mobility	Independent wheelchair mobility
SCIM III Score	72 / 100

Despite a complete (AIS A) injury, this patient achieves a HIGH SCIM score because thoracic-level paraplegia preserves full upper limb and hand function — independence in self-care and wheelchair mobility is achievable.

STEP 3: WISCI II Assessment

Finding	Score
Unable to walk	0

A complete thoracic SCI (AIS A) typically has minimal-to-no potential for functional ambulation, hence the WISCI score of 0.

STEP 4: SCI-QOL Assessment

Domain	Finding
Emotional adaptation	Good, despite paralysis

This is a key teaching point: even with a complete injury and no walking recovery, this patient demonstrates GOOD psychological adjustment — illustrating that quality of life and emotional coping are independent of injury severity.



CHAPTER 14

Comparison of Case 1 vs Case 2

Parameter	Case 1 (C6, Cervical)	Case 2 (T10, Thoracic)
Age/Sex	28-year-old male	35-year-old female
Mechanism	RTA	Fall
AIS Grade	C (Motor Incomplete)	A (Complete)
Sacral sparing	Present	Absent
Hand function (GRASSP)	Impaired — assessed	Not indicated (thoracic level)
SCIM III (initial)	38/100	72/100 (after rehab)
WISCI II	4 → 15 (improved)	0 (no ambulation potential)
SCI-QOL	Anxiety, fear of dependency	Good emotional adaptation
Key teaching point	Incomplete cervical injury: hand function priority + good walking recovery potential	Complete thoracic injury: upper limb/hand spared, high independence via wheelchair; psychological adaptation can still be excellent

Key Clinical Insight

- A higher (less severe) AIS grade does NOT automatically mean better quality of life
- GRASSP is reserved for cervical lesions where hand function is at stake
- SCIM III and WISCI II can show DIFFERENT trajectories — independence in self-care/mobility does not always correlate with walking recovery, and vice versa
- SCI-QOL must be assessed independently — it cannot be predicted from neurological or functional scores alone



CHAPTER 15

One-Line Exam Revision Table

Scale	What It Measures
ISNCSCI / ASIA	Neurological status (motor + sensory level)
AIS	Injury severity (A–E)
GRASSP	Hand function (cervical SCI only)
SCIM III	Independence in self-care, sphincter, mobility
WISCI II	Walking ability / assistance required
SCI-QOL	Quality of life, psychosocial wellbeing
MAS	Spasticity
Berg Balance Scale	Balance
10MWT	Walking speed
6MWT	Walking endurance



Remember the sequence: ASIA → AIS → GRASSP → SCIM → WISCI → SCI-QOL — this follows the patient's journey from neurological diagnosis, through functional recovery, to participation and quality of life. Best of luck in your physiotherapy studies!