Spinal Cord Injury

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Topic

A **spinal cord injury** (**SCI**) is damage to any part of the spinal cord or nerves extending from the spinal cord that often results in permanent changes in motor and/or sensory abilities and other body functions below the point of the injury. The physical impairments from SCI vary as a function of the level and completeness of the injury. Nearly every aspect of a person's life—physical health, work, personal relationships, and recreation—may be affected following SCI. Adjustment involves learning new adaptive behaviors and attitudinal change, so psychologists play a crucial role in assisting the rehabilitation process.

A. ***Key concepts***

1. **Neurological level of injury**

In 1982, the American Spinal Injury Association (ASIA) published an international classification of SCI that is still widely used to document motor and sensory impairments after SCI. The ASIA Impairment Scale (AIS) is determined by neurological responses of touch and pinprick sensations tested in each dermatome (area of skin supplied by a single spinal nerve) as well as the strength of key muscles on each side of the body corresponding to the neurological level of SCI. Research on prediction of outcomes has focused on the relationship between AIS classification within the first week and later recovery of function in traumatic injuries. In addition, AIS rating helps guide the rehabilitation process by identifying expected degree of physical independence for a given injury level:

AIS A/Complete	**No motor or sensory function** is preserved in the sacral segments S4-S5. The person has **no rectal/anal sensation**, sphincter contraction or other motor function below the neurological level, which is the lowest segment with nor mal sensory and motor function
AIS B/Sensory Incomplete	**Sensory** (but **no motor** function) is preserved below the neurological level; **includes** the sacral segments S4-S5. The person *has* anal sensation but no motor function below the neurological level. AIS B can be a transitional stage toward AIS C or D when some motor abilities recover below the neurological level.

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ASIA C/ Motor Incomplete	**Sacral sensation** and **motor function is preserved** below the neurological level with **less than 50** % of the key muscles below the neurological level having a **muscle grade of 3 or greater** (muscle grade 3 = active movement with full range of motion against gravity)
ASIA D/ Motor Incomplete	**Motor function** is preserved **below** the neurological level, and **more than 50** % of the key muscles below the neurological level have muscle grades of 3 or more
ASIA E/ Normal	**Motor and sensory functions are normal**. Essentially a person can have an SCI and neurological problems that are not detectable on a neurological examination of this type. **Note**: AIS classification may not be sensitive to subtle weakness, spasticity, pain, and some forms of dysesthesia that could be a result of spinal cord injury, which would then be classified AIS E

The neurological level may change over time in some cases and does not always correspond to the site of initial vertebral injury. For example, a C4 bone injury may start with a C4 neurological level and then recover function at C5 and C6, resulting in a neurological level of C6. Approximately 45 % of individuals with AIS A injuries gain at least one neurologic level in the first year. Among people with AIS A injuries, only 3 % regain functional strength for ambulation. Prognosis is more favorable for AIS B, C and D classifications, with 50 % or greater chance of ambulation [1].

2. **Tetraplegia**
   - Replaces the term "quadriplegia" to denote four limbs are involved, maintaining consistency with Greek derivation (tetra = 4; para = 2).
   - Cervical segments of spinal cord are affected, with impairment or loss of motor and/or sensory function below this level.
   - Primary impairment of function in arms, trunk, legs, and pelvic organs.
   - Does not include brachial plexus lesions or injury to peripheral nerves outside neural canal.
3. **Paraplegia**
   - Thoracic, lumbar, or sacral segments of spinal cord, with impairment or loss of motor and/or sensory function below this area.
   - Arm function intact, trunk, legs, and pelvic organs may be affected.
   - Refers to cauda equina and conus medullaris injuries, but not to lumbosacral plexus lesions or injury to peripheral nerves outside the neural canal [2].
4. **Complete SCI vs. Incomplete SCI**
   - "Complete SCI" refers to an injury resulting in complete loss of function below the neurological point of injury. "Incomplete SCI" refers to an SCI in which partial sensation or movement is evident below the point of injury.
5. **Traumatic SCI vs. Nontraumatic SCI**
   - Traumatic SCI is the direct result of trauma to the spinal cord from sudden application of physical force or movement that injures the cord by stretching, bruising, or displacement. Nontraumatic SCI designates injuries that occur because of medical conditions such as ischemia, spinal stenosis, infection, congenital disease, or tumor.
   - Nontraumatic SCI represents a significant portion of patients in rehabilitation, and some studies suggest similar incidence and prevalence as traumatic SCI [3, 4].
   - Rehabilitation needs are the same for all etiologies of SCI [5].
   - Individuals with traumatic SCI often achieve greater overall functional improvement, possibly due to younger mean age at injury [6].
6. **Autonomic Dysreflexia (AD)**
   - "Dysreflexia" refers to the abrupt onset of excessively high blood pressure caused by overactivity of the autonomic nervous system, triggered by a noxious stimulus below the level of injury. Individuals with SCI at T-6 or higher are most at risk.

- AD can be potentially life-threatening if not treated promptly and thus constitutes a medical emergency. AD occurs as a result of disconnection between the sympathetic and parasympathetic branches of the autonomic nervous system (ANS). For example, an overfull bladder sends sensory impulses toward the brain but is blocked by the lesion at the level of injury. The impulses evoke a reflex that increases the activity of the ANS, resulting in spasms, narrowed blood vessels, and an increase in blood pressure.
- Symptoms of AD include pounding headache, sweating above the level of injury, cold clammy skin below level of SCI, goose bumps, flushed face, slowed pulse (<60 beats per minute), blotching of the skin, and nausea.
- AD is caused by anything that would have been painful, uncomfortable, or physically irritating before the injury. Common causes of AD include blocked urinary catheter, bowel problems (e.g., distention and impaction), skin irritation or injury (e.g., an object in shoe/chair, overly tight clothing, wounds, and broken bones), and sexual activity (e.g., overstimulation, menstrual cramps, and labor and delivery).
- Persons with SCI at risk for AD need to learn to recognize symptoms and how to implement interventions (e.g., keeping head elevated, loosening clothing, checking for urinary blockage, and monitoring blood pressure).

7. **Spasticity**
   - Spasticity refers to sustained, involuntary muscle contractions and heightened muscular reflexes that occur below the neurologic level of injury. The majority of persons with SCI experience some degree of spasticity, which can limit function, cause contractures, and contribute to pain. Spasticity management often entails a long-term daily program of stretching exercises to maintain range of motion and the use of muscle relaxants such of baclofen or tizanidine.
8. **Neurogenic Bowel and Neurogenic Bladder**
   - Involves loss of voluntary bowel and bladder control caused by disconnection of sacral segments from the brain. Teaching strategies for maintaining bowel and bladder continence represents a major focus for rehabilitation.
9. **Bladder Catheterization**
   - Managing neurogenic bladder usually necessitates some form of catheterization (i.e., using a tube to allow the bladder to drain). An indwelling catheter ("Foley") remains in the bladder for continuous drainage, whereas intermittent catheterization (IC) entails inserting a catheter every 4–6 h. The use of IC is generally preferable because it is associated with a lower incidence of urinary tract infections, a common secondary complication of SCI. Suprapubic catheterization requires a surgery (cystostomy) to insert a catheter into the bladder through the abdominal wall. Advantages include prevention of damage to the urethal/sphincter tissue, maintenance of access for sexual activity, and reversibility.
10. **Bowel Program**
    - Includes techniques for enabling the bowel to empty in a regular fashion and to prevent stool incontinence. A bowel program involves the use of suppositories, enemas, laxatives, stool softeners, digital stimulation of the rectum to trigger colonic reflexes, or manual removal of stool. Regulation of diet, especially fiber intake, also plays a role. The combination of techniques that is effective varies from person to person.

11. **Pressure Injury**
    - People with SCI, especially AIS A injuries, have impairments in sensation and movement that interfere with spontaneous weight shifts while sitting or lying down. Prolonged pressure from stationary positioning causes compression and ischemia of soft tissue that can lead to deep tissue injury and open wounds over bony prominences, including the ischium, trochanter, and sacrum. Approximately 80 % of persons with SCI will develop a pressure injury at some point in the course of their disability, and 30 % will have more than one pressure injury [7].
    - Pressure injury risk factors include completeness of SCI, time since SCI, age, and nutritional status. Individuals with SCI need to develop new skills for skin care, such as turning in bed every two hours, and deliberately shifting weight while seated several times per hour.
    - Specialized wheelchair cushions and air mattresses are often prescribed for skin maintenance.
    - Behavioral factors such as psychiatric disorders, cognitive impairment, substance abuse, and smoking may increase risk for pressure injuries.
12. **Functional Independence Measure (FIM)**
    - **FIM** is a rating technique for describing a person's level of independence with respect to the motor and cognitive abilities required for basic activities of daily living, such as mobility, grooming, dressing, bathing, and toileting. FIM is based on a scale ranging from 7 (complete independence with no helper or assistive device needed) to 1 (helper or is needed for 100 % of task completion). FIM is the mostly widely utilized measure for tracking progress and measuring outcome of acute SCI rehabilitation.

Importance

- **Incidence and Prevalence**. SCI is a relatively infrequent but highly visible and costly disability, with an incidence rate of approximately 40 cases of traumatic SCI per million people annually, with a prevalence of approximately 270,000 persons in the United States. SCI mainly affects younger adults, with half of injuries occurring between the ages of 16 and 30; most (approximately 80 %) are male. African-Americans are overrepresented relative to the U.S. population as a whole, comprising around 23 % of injuries.
- The most common causes of traumatic SCI include moving vehicle crashes (36.5 %), falls (28.5 %), violence (14.3 %), and sports (9.2 %). Violent causes of SCI are much more common among ethnic minority groups. For example, violence accounts for about 44 % of injuries among African-Americans, compared to just 7 % for Caucasians [8]. Lifetime medical costs of having an SCI are high, ranging from 2.1 to 5.4 million dollars, depending on age at injury and injury level [9].

Practical Applications

A. ***Biopsychosocial Model***

Biopsychosocial models are helpful to understand the effects of physical impairments, psychological well-being, and social variables (e.g., community access, independent living, relationship role changes, and vocation) that are interrelated. Specialized knowledge about biological, psychological, and social aspects of SCI enhances rapport with persons served and helps optimize interventions for mental and physical outcomes. The goal is to formulate an individualized rehabilitation plan, collaborating with the person served in the context of the physical environment, social supports, and life values.

- Common social stereotypes promote the notion that people with SCI lead miserable lives, especially if they are completely paralyzed. However, a large body of

research shows most that level of SCI has limited or no effect on a person's psychological well-being, anxiety, depression, or quality of life [10, 11]. Variations in pre-injury personality, coping styles, cognitive appraisals, and social supports appear to play a larger role in adaptation than the level/extent of SCI, *per se*.

1. **Biological Aspects**
   - **Early intervention** and mobilization is crucial for recovery. Initiating rehabilitation efforts as early as possibly, even during critical care, may lead to better outcomes.
   - **Determine the ASIA Impairment Scale classification** from initial chart review and the associated functional expectations for a given level of injury, based on clinical practice guidelines. Understanding the degree of physical independence that the person served can reasonably achieve helps to guide expectations for recovery and define behaviors to target in rehabilitation. For example, a person with paraplegia may be able to attain complete independence with self-care using the right compensatory strategies, whereas someone with tetraplegia may need to focus on learning to direct care provided by others. Persons with AIS D injuries may recover a great deal motor function over time, whereas this is less likely for AIS A injuries. In addition, medical comorbidities and age may modify expected outcomes.
   - **Evaluate pain**. Although prevalence estimates for pain vary from study to study, a high proportion of persons with SCI experience acute and/or chronic pain that may interfere with effective engagement in rehabilitation. Acute pain that is undertreated can set the stage for development of chronic disorders. Neuropathic pain at or below the neurologic level of injury is common, typically described as diffuse burning, tingling, or band-like sensations that are relatively constant and worse at night for some people. Musculoskeletal pain occurs frequently as well, as a result of acute traumatic injury or as a consequence of overuse of the upper extremities for transfers and wheelchair propulsion. A 10-point numeric rating scale is the most widely accepted metric, with 0 indicating "no pain" and 10 indicating "worst pain imaginable." Standard assessment explores current pain level, worst and best levels, acceptable or bearable level, aggravating/alleviating factors, and interference with life activities.
   - **Assess for co-occurring Traumatic Brain Injury** (**TBI**). Many people with traumatic SCI also sustain a TBI, particularly in high-speed moving vehicle crashes or falls. Incidence estimates vary anywhere from 16 to 59% [12]. A review of medical records may indicate severity parameters: any documented loss of consciousness, initial Glasgow Coma Scale performance, neuroradiologic findings, and duration of posttraumatic amnesia. However, this information may not be available, particularly in less severe injuries. Lifetime exposure to TBI can be gauged through structured interview techniques [13]. It is helpful to incorporate cognitive screening into early assessment and consider neuropsychological evaluation for individuals who present with impairment.
2. **Psychological Aspects**
   - **Evaluate Depression**. Most people (roughly 70%) do *not* become depressed following SCI, reflecting the widespread resilience of human beings under challenging circumstances. Nevertheless, depression is the most commonly reported psychological disorder following SCI.

The occurrence of severe depression is associated with longer hospitalizations, less functional independence after discharge, and potentially preventable secondary complications such as pressure injuries and urinary tract infections. In addition, persons with SCI have increased suicide risk. Recognizing and treating depression represents a major priority in the rehabilitation setting.

- **Assessment**: Some common tools to assess depression are **Beck Depression Inventory** (**BDI-II**) and the **Patient Health Questionnaire-9** (**PHQ-9**). The latter instrument has been validated in the SCI population and is likely preferable. The PHQ-9 quantifies the core symptoms of major depression, with scores of 10 or above suggesting probable mood disorder. The **SIGECAPS** mnemonic (**low mood** plus changes in **S**leep, **I**nterests, **G**uilt, **E**nergy, **C**oncentration, **A**ppetite, **P**sychomotor changes, and **S**uicidal thoughts) can aid in making a thorough appraisal within an interview context. When examining depression in an SCI setting, it is important to consider shared qualities inherent in both conditions that may affect self-reported symptoms. (e.g., people with SCI may have problems sleep due to need to reposition in the night or pain, reduced energy related to medication, weight changes, and occasional down days).
- **Intervention**: Recent research suggests that depression in SCI is vastly undertreated. For example, a large-scale study found that less than 12% of persons with probable major depression received psychotherapy or an effective dose of antidepressant in the prior 90 days [14]. Traditional treatment strategies for depression appear effective in the context of SCI [15].

- **Screen for Substance Use Disorders**. Studies suggest a high rate of alcohol intoxication at time of injury for persons with SCI, ranging from 29 to 40%, and intoxication with other substances is frequently seen as well. Contrary to stereotypes, having an SCI likely does not cause people to start using substances as an avoidance mechanism. Instead, substance use after injury usually involves gradually resuming preinjury patterns of use after active rehabilitation has ended. One large-scale study of people with SCI living in the community found that 14% of participants described problematic alcohol use and 11% endorsed use of illegal or nonprescribed drugs.
  - **Assessment**: Routine substance use screening is essential for the SCI population. Instruments, such as the Alcohol Use Disorders Identification Test-Condensed (AUDIT-C) or CAGE Questionnaire, offer a systematic means for identifying people at risk [16].
  - **Intervention**: Many people experience readiness to change when faced with a radically altered situation. Individuals with substance dependence may have gone through withdrawal in the intensive care unit prior to rehabilitation, with remission in a structured setting. Major treatment efforts for substance use disorders typically cannot occur during acute rehabilitation because of time constraints. However, brief interventions focused on motivational interviewing, education, and reducing barriers to treatment can be effective [17].
- **Explore Adaptation to disability**. Traditional "stage theories" of adjustment to disability have not been validated by clinical research. Although normal responses to disability may encompass shock, denial, depression, anger, anxiety, acknowledgement, and acceptance, coping appears to be nonlinear, and each person's experience is unique. Some disability theorists prefer the term "adaptation" over "adjustment," because adapting implies an ongoing process with inherent fluctuations

rather than an idealized endpoint with successful achievement or failure [18]. Contemporary models of adaption emphasize personality factors and individual differences, environmental and social characteristics, and cognitive appraisals [19]. Current research has examined individual coping patterns over time, identifying trajectories of resilience, recovery, and distress. The majority of people with SCI present with a pattern of resilience or recovery [20]. Understanding attitudes toward disability is crucial because such beliefs are potentially modifiable.

- **Assessment**: There is no simple method or questionnaire for evaluating adjustment to disability. Measures of cognitive appraisals, self-efficacy, self-esteem, and optimism have been correlated with well-being, but none are universally accepted as a standard of practice [21]. In the acute rehabilitation setting, willingness to engage in therapies and learn new strategies for self-care often becomes the proxy definition of adaptation; individuals who refuse or avoid treatment are usually referred for psychological services. Rehabilitation-oriented assessments typically combine traditional distress screening along with exploration of attitudes toward disability.
- **Intervention**: Psychotherapeutic intervention usually focuses on processing emotions, modifying negative appraisals about SCI, enhancing social skills/assertiveness related to disability, practical problem-solving, and increasing disability-specific knowledge for both the person served and family members. It is extremely important for the team as whole to provide behavioral activation and to orchestrate experiences of mastery, enjoyment, and community integration such as recreational outings.

- **Address Quality of Life**. Most people living with SCI report having an acceptable quality of life (QOL). Level and severity of injury do not predict self-reported negative QOL. Correlates of increased life satisfaction and positive affect include higher education, employment, longer time since injury, better physical health/absence of secondary complications, social support, having a spouse/partner, transportation/community access, absence of chronic pain, and having a subjective sense of purpose or meaning [22].
  - **Assessment**: The **Satisfaction with Life Scale** (**SWLS**), a five-item, Likert scale instrument that measures perceived life satisfaction, is the measure employed by the SCI Model Systems and the Department of Veterans Affairs Spinal Cord Injury System of Care. **The Short Form (36) Health Survey** (**SF-36**), which evaluates quality of life/life satisfaction in eight different domains, is another widely used quality of life measure.
  - **Intervention**: With individuals who report a lower quality of life, it is helpful to explore their perceptions of what barriers exist using **open-ended questions** (i.e., "What would have to change for you to feel happier?"—"What's missing for you?," etc.). Interdisciplinary interventions should address medical problems, equipment needs, untreated depression, or other modifiable factors, tailored to the individual case.
- **Discuss Sexuality and Sexual Health**. Regardless of age and health status, people have a need to express their sexuality in some form, despite stereotypes that tend to portray persons with disabilities as asexual. SCI usually affects physiologic aspects of sexual response (erectile function for men and lubrication/vaginal contractions for women), creating an altered experience that necessitates experimentation to learn what is satisfying. Studies suggest that individuals with SCI potentially can have similar levels of sexual satisfaction as those without an injury.
  - **Assessment**: People often do not spontaneously inquire about sexual concerns due to embarrassment or social inhibitions, so it is essential for providers to

raise this topic in a nonjudgmental fashion as part of care. Direct questioning is essential, such as "Has anyone talked to you about sexuality since your injury?" or "After a spinal cord injury, most people have questions related to sexuality and sexual activity; can you tell me about your concerns?" It is common for individuals in the acute stage of SCI to focus on overall general physical recovery during rehabilitation.

– **Intervention**: Identify one or more individuals from the treatment team to consistently address sexual health needs. A widely accepted intervention approach is the **PLISSIT model**, which characterizes levels of intervention based on readiness and individual needs [23]. **P**ermission-giving refers to openly encouraging people to talk about and engage in sexual activity. **L**imited **I**nformation entails education about general aspects of sexuality following SCI. **S**pecific **S**uggestions offer prescriptions for positioning or other techniques based upon the person's unique situation. Finally, **I**ntensive **T**herapy may be required for people with preexisting sexual dysfunction or complex sexual histories. Referral to a specialist in sex therapy may be warranted.
– Biological interventions for erectile dysfunction include medications, vacuum pumps, and penile implants, needing medical evaluation and physician orders. Reproduction and fertility are highly possible but warrant specialized supports in many instances. For example, men with spinal cord injury can have reduced sperm quality and difficulty ejaculating, so methods such as electrical stimulation or vibration may be helpful. Women who become pregnant following SCI need prenatal and delivery care that takes injury characteristics like risk for pressure injuries or dysreflexia into account.

3. **Social Aspects**
   - **Involve families and significant others in the rehabilitation process**. Involvement of family and friends is a critical variable in recovery and community integration for person with SCI. Persons with SCI may develop new needs for instrumental and emotional support that families are in the best position to provide, so family members need specific education and support to facilitate the caregiving role. Stress associated with the catastrophic nature of SCI may activate unhealthy family dynamics and conflicts that can complicate rehabilitation. Psychological intervention is frequently helpful for understanding and reducing emotional barriers to family adjustment. Over the long term, caregivers may benefit from support services aimed at reducing burden and burnout.
   - **Attend to cultural and diversity issues**. Diversity variables—gender, ethnicity, cultural background, sexual orientation, language, and religious beliefs—can greatly affect individual experiences of rehabilitation. Health care systems tend to embody mainstream culture and authority, which may create fear, mistrust, and misunderstanding for diverse consumers. It is important for interventions to incorporate active efforts to learn about and respect cultural preferences and thereby reduce the risk of alienation from the rehabilitation team. At the same time, certain values may be gently questioned. For instance, in some religious belief systems, the occurrence of disability signifies a moral flaw or wrongdoing of the person, and it might be helpful for the team to carefully offer alternative perspectives.

- **Facilitate vocational interests and employment**. Research suggests that competitive employment is associated with better quality of life following SCI, yet the rate of unemployment is high in this population. Instilling the idea that people can and should work if they wish constitutes a priority in care. Supported employment has been shown to be an effective strategy for increasing successful job placement [24]. Educational pursuits represent another desirable means of social participation.
- **Provide instruction about disability rights**. Persons with SCI may experience social discrimination and marginalization because of their disability status. Ideally, the rehabilitation process enhances awareness of social barriers and encourages self-advocacy for civil rights. In the United States, the Americans with Disabilities Act (ADA) of 1990 prohibits discrimination with respect to employment, transportation, and public accessibility. The ADA is a productive focal point for education.

Tips

- ***Language matters***. Focus on the person first Avoid outmoded and value-laden language such as "wheelchair bound," "confined to a wheelchair," "unfortunate" individual who "suffered" an injury, and so on.
- ***Normalize stress and intense emotional reactions to disability***. In the ideal situation, the psychologist sees every person admitted for rehabilitation, integrating mental health into the overall plan of care and enabling psychological understanding for the team and persons served. Even when psychology is only consulted for problematic cases, it facilitates acceptance to introduce psychological services as a means of addressing quality of life concerns and stress management, rather than as a traditional treatment for mental disorders.
- ***Embrace openness to experience***. Some people perceive SCI as a gift while others view it as a fate worse than death (indeed, one individual might have both responses at different times). Cultivating flexibility in yourself may assist you in allowing others to approach tasks and goals in a different way.
- ***Consult with your team***. Gathering team perspectives on care helps build cohesion and enhances assessment.
- ***Be aware of boundaries***. It is critical to respect boundaries of confidentiality in the rehabilitation setting. Employ informed consent as well as circumspection in sharing sensitive information about the person served with family members and the team, in order to strike an ethical balance between collaborating with other professionals and minimizing intrusions on privacy. For example, if you meet separately with a family member to discuss family functioning or provide education, assume that the substance of your interactions will be disclosed and discussed with the person in rehabilitation.

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