



Pursuing Independence after SCI: Now What?

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Objectives

You will be able to:

1. List 3 common secondary complications after spinal cord injury.
2. Describe at least 3 interventions to promote mobility independence for a client with a thoracic level of injury.
3. Develop a personalized, truthful, and compassionate answer to the question “Will I walk again?”

Special Acknowledgement:

- Spinal Cord Injury Seminars, Inc
 - www.sciseminars.com
 - Resources Page – recommended YouTube videos
 - Comprehensive SCI education “from injury to home again”
 - Darrell Musick, PT – Owner, Founder
 - Rafferty Laredo, OT Presenter
 - Rachael Houtman, PT Presenter

tower 3
T306
Rehab Gym



↑ Patient Rooms T362-T373
→ Patient Rooms T350-T361
→ Family Lounge



Where do I start?

- Diagnosis
- Prognosis
- Medical Complications
- Treatment Progression

ISNCSCI Resources

American Spinal Injury Association (ASIA)

<http://www.asia-spinalinjury.org/>

- ASIA Learning Center
 - InSTEP and WeeSTEP Modules
 - ISNCSCI Exam Sheet
 - Sensory exam guide
 - Motor Exam Guide

Classification - <http://www.isncscialgorithm.com/>

Case 1

RIGHT		MOTOR KEY MUSCLES		SENSORY KEY SENSORY POINTS Light Touch (LT) Pin Prick (PP)		SENSORY KEY SENSORY POINTS Light Touch (LT) Pin Prick (PP)		MOTOR KEY MUSCLES		LEFT		
	C2		2		2		2		C2			
	C3		2		2		2		C3			
	C4		2		2		2		C4			
	C5	Elbow flexors	5		2		2		5	C5	Elbow flexors	
	C6	Wrist extensors	5		2		2		5	C6	Wrist extensors	
	C7	Elbow extensors	5		2		2		5	C7	Elbow extensors	
	C8	Finger flexors	5		2		2		5	C8	Finger flexors	
	T1	Finger abductors (little finger)	5		2		2		5	T1	Finger abductors (little finger)	
Comments (Non-key Muscle? Reason for NT? Pain?): <div style="border: 1px solid black; height: 80px; width: 100%;"></div>			T2		2		2		T2			
			T3		2		2		T3			
			T4		2		2		2	T4		
			T5		2		2		2	T5		
			T6		0		1		0	T6		
			T7		0		0		0	T7		
			T8		0		0		0	T8		
			T9		0		0		0	T9		
			T10		0		0		0	T10		
			T11		0		0		0	T11		
			T12		0		0		0	T12		
			L1		0		0		0	L1		
	L2	Hip flexors	0		0		0		0	L2	Hip flexors	
	L3	Knee extensors	0		0		0		0	L3	Knee extensors	
	L4	Ankle dorsiflexors	0		0		0		0	L4	Ankle dorsiflexors	
	L5	Long toe extensors	0		0		0		0	L5	Long toe extensors	
	S1	Ankle plantar flexors	0		0		0		0	S1	Ankle plantar flexors	
	S2		0		0		0		0	S2		
	S3		0		0		0		0	S3		
	S4-5		0		0		0		0	S4-5		
	(VAC) Voluntary anal contraction (Yes/No) N										N (DAP) Deep anal pressure (Yes/No)	
RIGHT TOTALS									LEFT TOTALS			
		(MAXIMUM)	(50)	(56)	(56)	(56)	(56)	(50)			(MAXIMUM)	

MOTOR SUBSCORES

UER + UEL = UEMS TOTAL
 MAX (25) (25) (50)

LER + LEL = LEMS TOTAL
 MAX (25) (25) (50)

SENSORY SUBSCORES

RLT + LLT = LT TOTAL
 MAX (56) (56) (112)

RPP + LPP = PP TOTAL
 MAX (56) (56) (112)

NEUROLOGICAL LEVELS
 Steps 1-5 for classification as on reverse

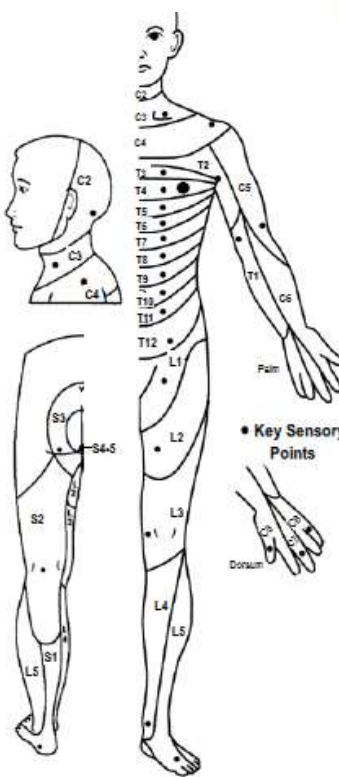
1. SENSORY **T5 T5**
 2. MOTOR **T5 T5**

3. NEUROLOGICAL LEVEL OF INJURY (NLI) **T5**

4. COMPLETE OR INCOMPLETE? **C**
Incomplete = Any sensory or motor function in S4-5

5. ASIA IMPAIRMENT SCALE (AIS) **A**

(In complete injuries only)
ZONE OF PARTIAL PRESERVATION
Most caudal level with any innervation
 SENSOR **T6 T7**
 MOTOR **T5 T5**



MOTOR (SCORING ON REVERSE SIDE)

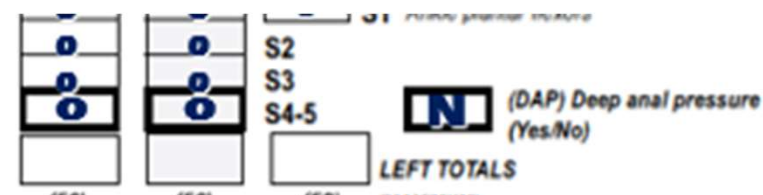
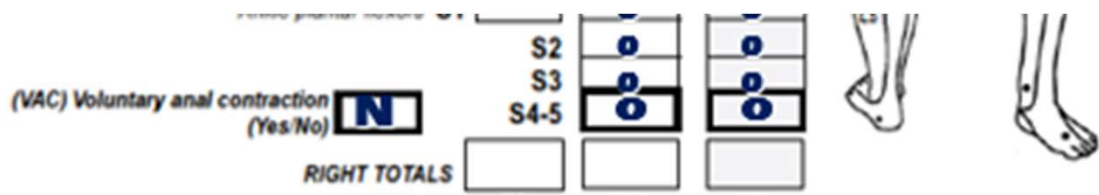
0 = total paralysis
 1 = palpable or visible contraction
 2 = active movement, gravity eliminated
 3 = active movement, against gravity
 4 = active movement, against some resistance
 5 = active movement, against full resistance
 5+ = normal corrected for pain/illness
 NT = not testable

SENSORY (SCORING ON REVERSE SIDE)

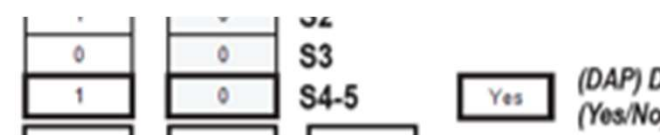
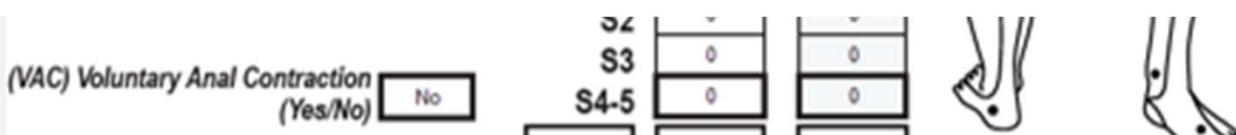
0 = absent
 1 = altered
 2 = normal
 NT = not testable

Complete vs Incomplete Injury

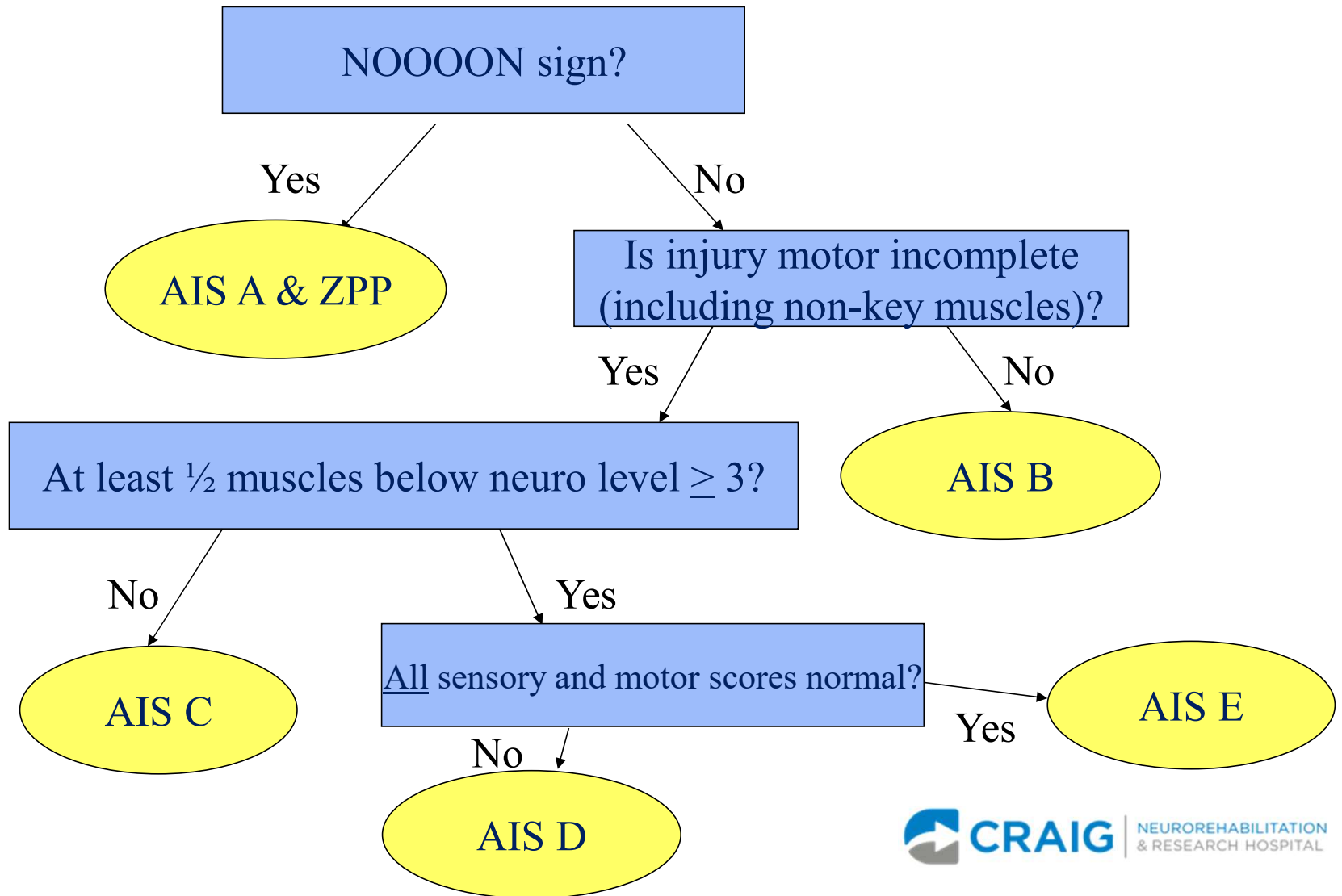
- AIS A Complete – NOOON sign



- Incomplete – No NOOOON sign



Most important long-term prognosis indicator



Predictability of Neurological Recovery

- Severity of Injury
 - Neuro recovery: AIS C > B > D > A
- Age less than 50 at time of injury (AIS C)
- Initial level of injury
 - Rates of conversion from complete to incomplete: Lumbar > Cervical > Low paraplegia > High paraplegia
- Initial strength of the muscles

General Trends in Recovery

- Most rapid recovery – 1st 3 months
 - Majority of recovery – 1st 6-9 months
 - Plateaus in recovery – 12-18 months
 - Some late recovery – 2-5 years
- Kirshblum, Chay 2020
- Faster initial recovery results in greater overall improvement
 - Locomotor CPG – high intensity gait training improves distance and speed of gait for indiv with incomplete injuries >6 mo post injury

Recovery in Complete Tetraplegia

- Most patients regain one “motor level” per ISNCSCI (ie. C5 motor > C6 motor)
- 90% of muscles with initial strength of 1/5 or 2/5 at 1 wk to 1 mo recover to $\geq 3/5$ by 1 year.
- LE recovery is low (<10%) if AIS A for >1 mo post injury

Recovery in Complete Paraplegia

- Poor prognosis for conversion from complete to incomplete
- Neurologic Level of Injury above T9 - no gain in motor function at 1 year
- Low paraplegia (T10-12) – greater LE motor scores and higher FIMs at 1 year

Recovery in Motor Incomplete SCI

- Improved prognosis
 - 52% AIS C convert to AIS D
- Amount of sacral sparing predicts conversion to AIS D
 - Initial + Voluntary anal contraction, deep anal pressure, light touch and pinprick at S4-5 → 87% converted from C to D

Clinical Prediction Rule van Middendorp 2011

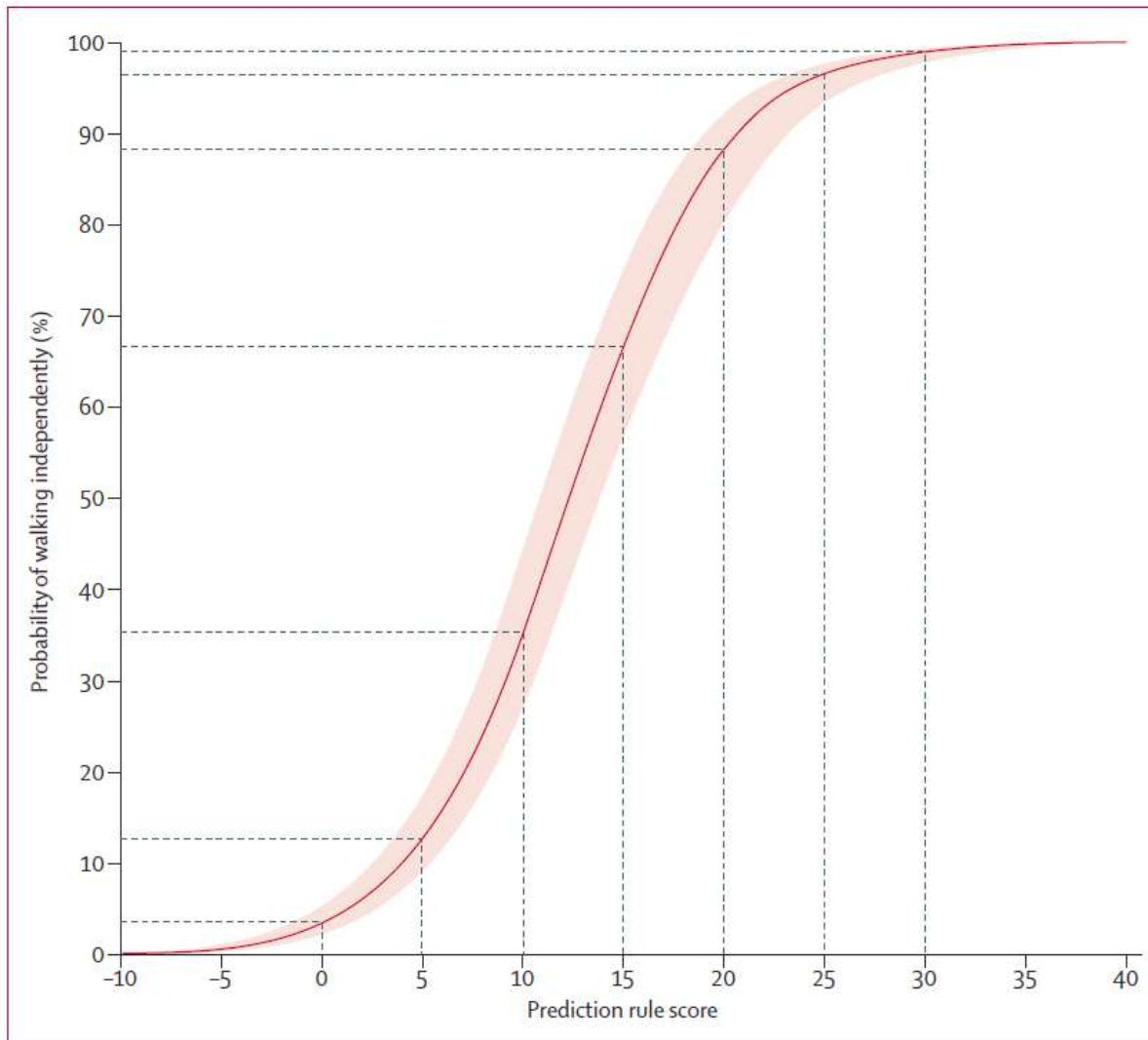
	Range of test scores	Weighted coefficient	Minimum score	Maximum score
Age \geq 65 years	0-1	-10	-10	0
Motor score L3	0-5	2	0	10
Motor score S1	0-5	2	0	10
Light touch score L3	0-2	5	0	10
Light touch score S1	0-2	5	0	10
Total			-10	40

Only the best score of each motor score or light touch score (ie, right or left) should be applied for the prediction rule (see Methods).

Table 2: Clinical prediction rule variables

Item Score x Weighted Coefficient = Weighted Item Score

Add all Weighted Item Scores together = Total “Prediction Rule Score”



Find Prediction Rule Score on the X axis and its correlated Probability of Walking Score on the Y axis

Figure 2: Probability of walking independently 1 year after injury based on the prediction rule score
 The shaded area around the curve is the 95% CI of the prediction rule based on the regression model. The dotted lines are a visual aid to determine the probability of walking independently.

Maintaining Hope, Role of Denial

- Denial can be a protective component of coping
- Confronting denial only results in conflict
- Relationship and alliance allows aligning of expectations
- Maintenance of hope is pivotal for relationship building and continued motivation within rehabilitation

Recommendations for Discussing Prognosis –

Kirshblum et al 2016

- Early after injury
- By an experienced SCI clinician or physician
- Sit close
- Maintain eye contact and body language to convey warmth sympathy, encouragement, reassurance
- Speak slowly, deliberately and clearly

When are we going to work on my legs? I want to walk.

- “I really hope you do. I would love to see that happen. Right now, no one knows how to fix muscles that aren’t working on their own, but it’s likely you will be the first one to notice any changes in your muscles or movements. Let me know when/if that happens, and I will work my hardest to help you get stronger. In the meantime, we are going to work on strengthening and preparing the rest of your body by getting out of bed, strengthening the muscles that are working and helping you be as independent as you can be right now ...”

Upper Motor Neuron Injury (UMN)

- Central nervous system affected
- Preserved reflexes - Hyperreflexia
- “Spasticity”
- Neurogenic bowel and bladder – spastic sphincters
- Preserved reflexive penile erection in males

Lower Motor Neuron Injury (LMN)

- Peripheral Nervous system affected
- Loss of reflexes
- “Flaccidity”
- Flaccid bowel and bladder – flaccid sphincters
- No reflexive erection in males

Pressure Injury



**Danger:
What Do We
Do?**

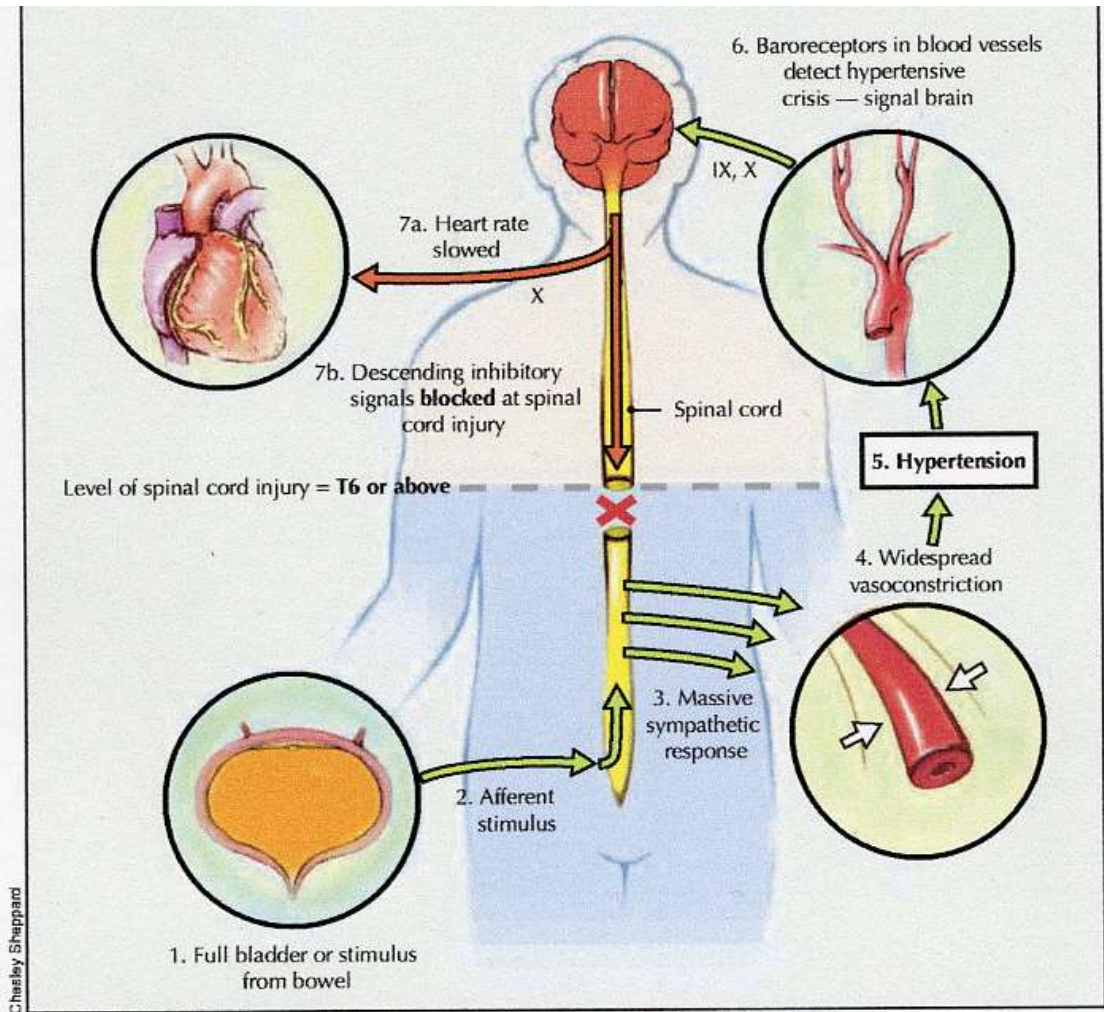


Fig 1: Diagram illustrating how autonomic dysreflexia occurs in a person with spinal cord injury. The afferent stimulus, in this case a distended bladder, triggers a peripheral sympathetic response, which results in vasoconstriction and hypertension. Descending inhibitory signals, which would normally counteract the rise in blood pressure, are blocked at the level of the spinal cord injury. The roman numerals (IX, X) refer to cranial nerves.

Autonomic Dysreflexia

Seating and Positioning



- Minimize width of chair to prevent shoulder abd/IR with propulsion
- Hips all the way back – gap btwn back/cushion for buttock/sacrum
- Full thigh support
- Recline backrest for balance – able to eat a sandwich with 2 hands
- Wheel access – elbow@100-120 deg w/ hand at 12:00 on rim
- COG – balanced wheelie, casters ≤ 4 ” from ground

PVA CPG - Preservation of Upper Limb Function Following Spinal Cord Injury

Pressure reliefs and Propulsion

- Pressure Reliefs

- Forward, Side to side, Push up, Dependent Tilt back
- 2 min, at least every 30 min
- Unweight – full lift not necessary

- Propulsion

- Semicircular – most efficient, least impact
- https://www.physio-pedia.com/Wheelchair_Biomechanics
- YouTube: “MAX Mobility - Propulsion Training 101”

Functional Progression

- Wheelchair mobility
- Balance
- Scooting
- Rolling
- Supine to long sit



- Transfers (w/c <> mat/bed)
- Short sit to long sit
- Floor to mat/wheelchair
- (Advanced wheelchair skills)

Rolling – T5 AIS A



Rolling – 5 weeks later



Supine to Long sit



Transfers



Seated pushups – common mistakes



- ▶ Hands just in front of trochanters, not at edge of mat
- ▶ Press down, don't "hop"
- ▶ Keep head down, chin tucked



Staple maneuver

- Trailing hand close to hip
- Lead/balance hand forward and out slightly;
- “Lift, pivot, sit” or “up, over, down” with control

This patient lacks scapular depression strength

- Can lift with knees blocked and with assistance
- Shoulders stay elevated and “lift” is lacking without assistance



The Goal



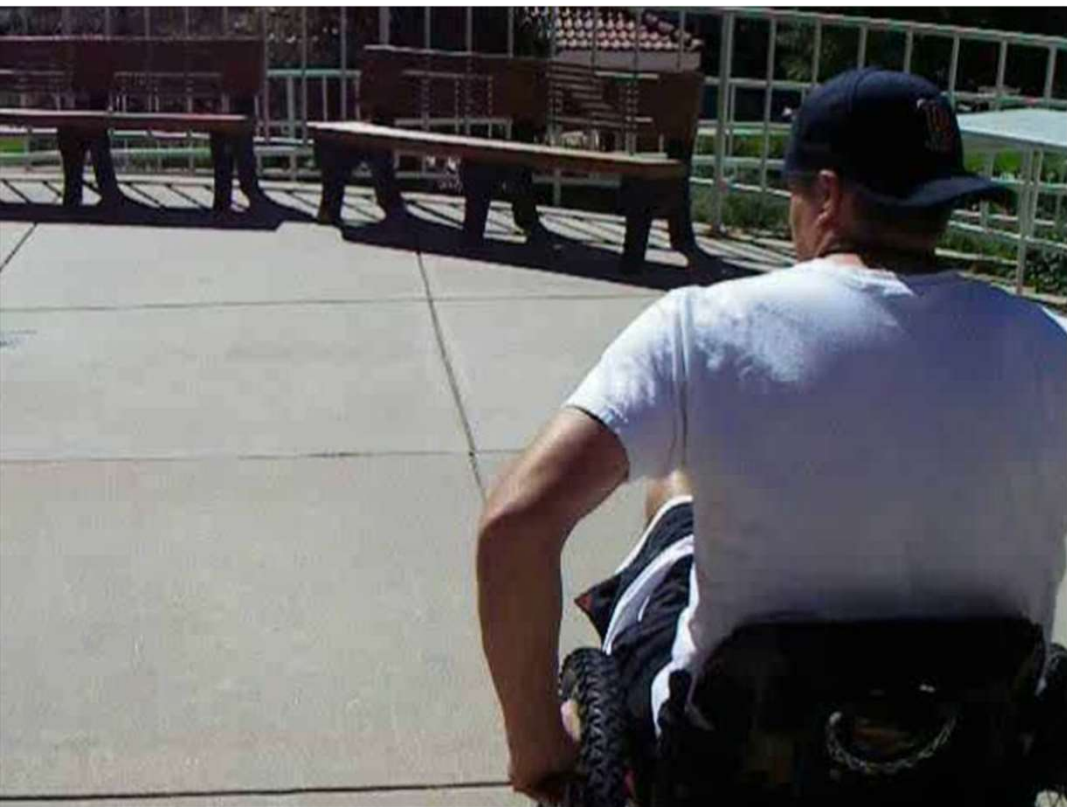
SCI Seminars, Inc www.sciseminars.com

SUV Transfer - Paraplegia



Paraplegic Transfer into 4x4 Tahoe – YouTube

Wheelchair Skills



Wellness and Fitness



Motor Incomplete Injuries

- Build a foundation of stability – LE and Core Strength
- Introduce upright mobility early
- High Intensity Training to promote walking recovery
- Maximize LE stability/strength to decrease UE dependence
- Promote optimal mechanics to increase intensity safely
- Maximize adaptability/balance





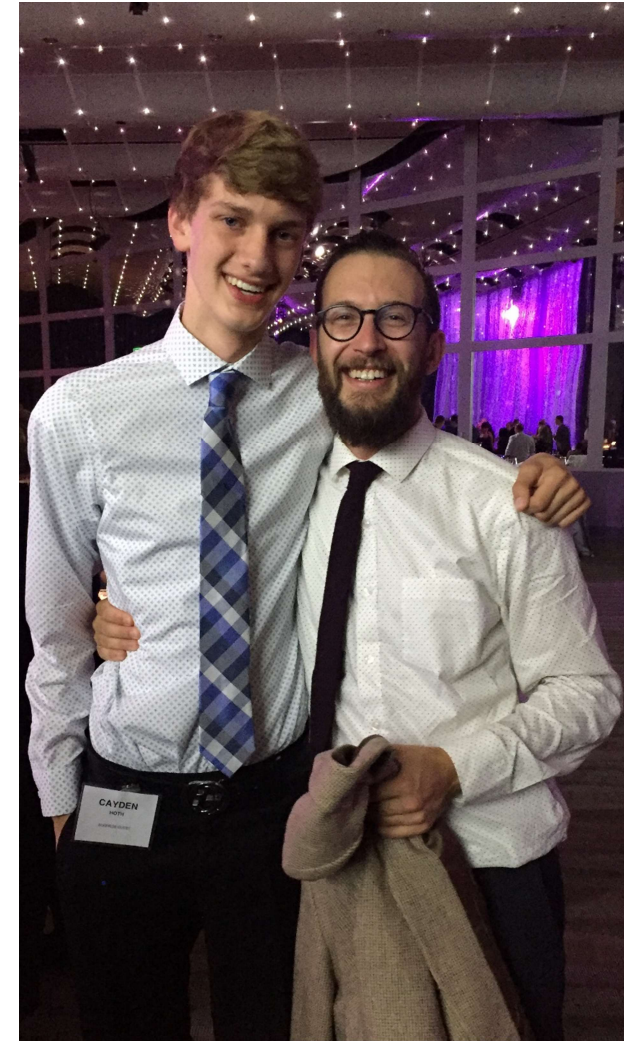
Craig Hospital

Redefining Possible for People with Spinal Cord and Brain Injuries

Cayden Hoth
Redefining Each Step

Future Considerations for All Individuals with SCI

- Continued Rehab – outpatient, wellness/fitness
- Regular SCI-specific re-evaluations
- Aging with SCI
 - Nutrition/ weight management
 - Shoulder preservation
 - Joint protection
 - Skin protection
 - Cardiovascular health



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Thank you!

