

# ACADEMY OF SPINAL CORD INJURY PROFESSIONALS

## The presence or absence of midsagittal tissue bridges and walking: a retrospective cohort study in spinal cord injury



Thornton WA,<sup>1</sup> Marzloff G,<sup>2</sup> Ryder S,<sup>2</sup> Best A,<sup>2</sup> Rasheed K,<sup>1</sup> Coons D,<sup>2</sup> Smith AC.<sup>1</sup>

University of Colorado School of Medicine, Department of Physical Medicine and Rehabilitation, Physical Therapy Program, Aurora, CO USA<sup>1</sup>  
Rocky Mountain Regional VA Medical Center Spinal Cord Injury & Disorders Center, Aurora, CO USA<sup>2</sup>

### Background

- There is a growing research focus on **midsagittal tissue bridges (MSTB)**
- MSTBs are lesion characteristics measured on T2-weighted magnetic resonance images (MRIs) following spinal cord injury (SCI)
- MSTBs are a surrogate measurement of **preserved neuronal tissue** adjacent to the lesion
- The presence and widths of MSTBs are associated with **improved function** following SCI
- Objective: to evaluate the relationship between the **presence/absence** and widths of MSTBs and **walking ability** among veterans with chronic SCI

### Methods

- Retrospective examination of 22 veterans with predominantly chronic cervical SCI
- T2-weighted MRIs and clinical documentation were used for data analysis
- Computer software determined the presence or absence of a MSTB
- If present, the widths of ventral and dorsal tissue bridges were measured
- MSTB characteristics were then related to the participants' ability to walk
- Walking ability was based off examination of clinical documentation.
- MRI assessors were blinded to participants' walking ability

### Results

- **14** of the analyzed participant images revealed the presence of midsagittal tissue bridges ventrally and/or dorsally
- **71%** of those individuals **possessed overground walking ability**
- The 8 individuals with **no apparent tissue bridges** were **all unable to walk**
- There was a significant correlation between walking and widths of ventral midsagittal tissue bridges ( $r=.69$ ,  $95\%CI: .52, .92$ ,  $p<.001$ ), as well as dorsal midsagittal tissue bridges ( $r= .44$ ,  $95\%CI: .15, .73$ ,  $p < .05$ )

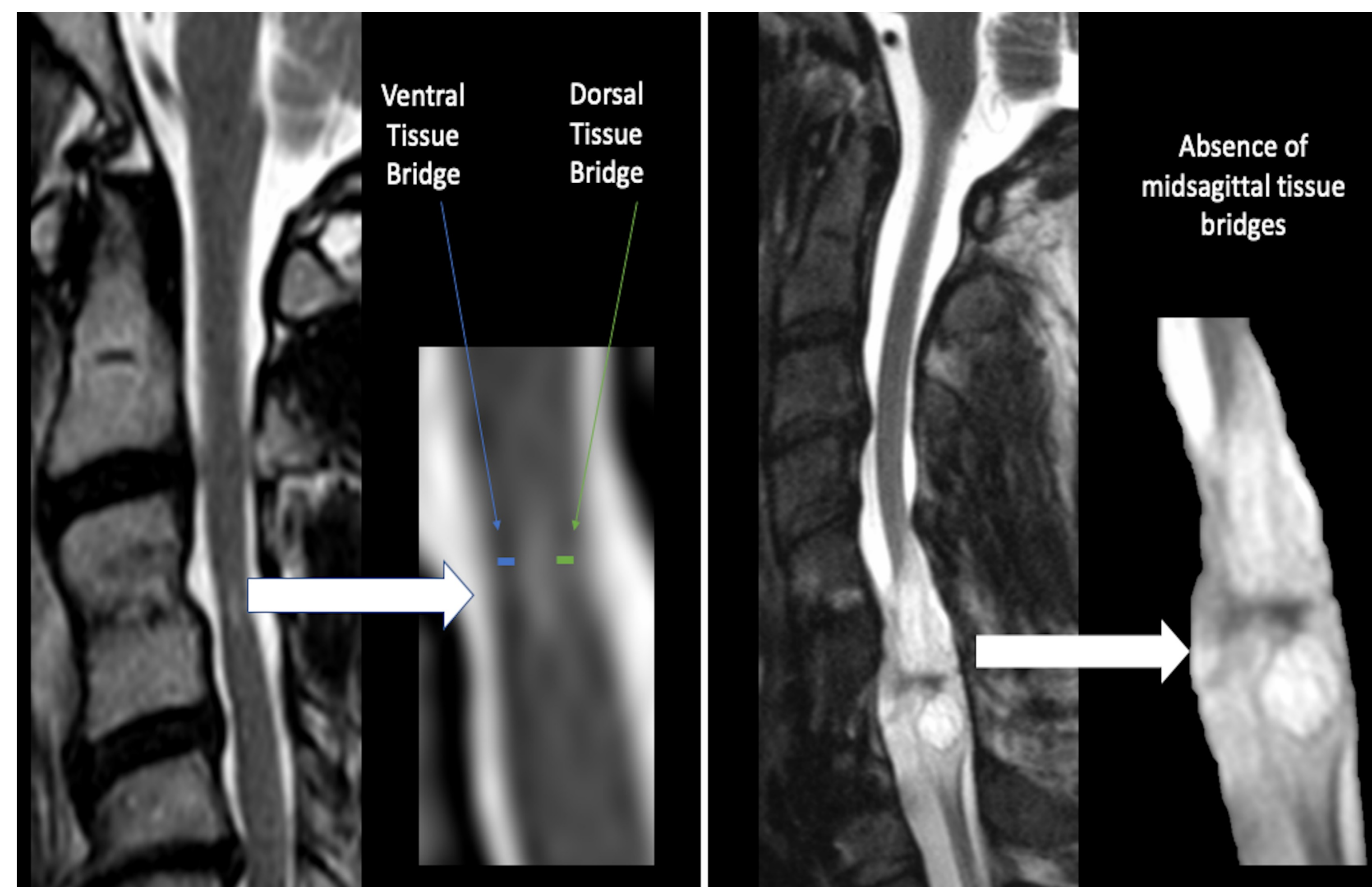


Fig 1: Examples of the presence and absence of midsagittal tissue bridges using the midsagittal T2 weighted scan of the cervical spine. On the left panel, the ventral tissue bridge is depicted in blue. The dorsal tissue bridge is depicted in green. On the right panel, there is no evidence of preserved tissue bridges

	Walking	Not Walking
Tissue Bridges Present	10	4
Tissue Bridges Absent	0	8

Table 2: 2x2 table comparing presence of tissue bridges to walking ability

Gender	Age at Ambulation Assessment (yrs.)	Neurologic Level	AIS grade	DOI-MRI date (yrs.)	DOI-Ambulation Assessment (yrs.)	Ventral Tissue Bridge Width (mm)	Dorsal Tissue Bridge Width (mm)	Walking Ability (Yes/No)
M	83	C1	A	43.3	57.4	.57	.49	No
M	40	C6	A	17.1	17.2	0	0	No
M	59	C3	A	5.3	11.8	0	0	No
M	62	C4	A	32.7	32.7	0	0	No
M	65	C2	A	1.0	1.0	0	0	No
M	61	C4	C	5.0	7.2	0	0	No
M	76	C5	C	3.7	3.7	0	0	No
M	74	C1	C	.6	6.9	0	0	No
F	30	C2	C	2.2	3.0	0	.66	No
M	73	C1	C	37.1	41.8	0	.55	No
M	62	C2	C	5.2	5.2	.45	.42	No
M	66	C1	D	36.2	39.0	.98	1.03	Yes
M	78	C1	D	.8	1.7	.95	2.78	Yes
M	60	C1	D	0	.24	0	0	No
M	49	C2	D	10.9	16.9	1.01	.92	Yes
M	51	C2	D	.04	.24	0	.59	Yes
M	54	C2	D	4.3	4.5	1.26	1.31	Yes
M	69	C1	D	0	.36	2.36	0	Yes
M	73	C1	D	.24	.22	.60	.41	Yes
M	69	C2	D	40.9	46.0	.71	.43	Yes
M	51	C2	D	0	.37	.63	0	Yes
M	57	C2	D	15.3	15.5	.49	0	Yes

Table 1: Descriptive data Abbreviations: AIS, American Spinal Injury Association Impairment Scale; DOI, Date of Injury; MRI, magnetic resonance image

### Conclusions

- The evaluation of MSTBs may be useful in various rehabilitation settings
- MSTB presence or absence may help inform patients' plan of care and allocation of resources
- Presence and width of MSTB may assist with appropriate stratification into research cohorts

### Implications/Limitations

- MSTB evaluation may be utilized by practitioners not well-versed in ISNCSCI performance or interpretation
- Findings suggest those with no evidence of MSTBs should continue to emphasize compensatory strategies
- This study did not explore the walking interventions these individuals may or may not have received post-injury

### References

- Berliner JC, O'Dell DR, Albin SR, et al. The influence of conventional T2 MRI indices in predicting who will walk outside one year after spinal cord injury. *The Journal of spinal cord medicine*. 2021;1-7.
- David G, Seif M, Huber E, et al. In vivo evidence of remote neural degeneration in the lumbar enlargement after cervical injury. *Neurology*. Mar 19 2019;92(12):e1367-e1377. doi:10.1212/WNL.00000000000007137
- Huber E, Lachappelle P, Sutter R, Curt A, Freund P. Are midsagittal tissue bridges predictive of outcome after cervical spinal cord injury? *Ann Neurol*. May 2017;81(5):740-748. doi:10.1002/ana.24932
- O'Dell DR, Weber KA, Berliner JC, et al. Midsagittal tissue bridges are associated with walking ability in incomplete spinal cord injury: A magnetic resonance imaging case series. *J Spinal Cord Med*. Mar 2020;43(2):268-271. doi:10.1080/10790268.2018.1527079
- Pfytter D, Huber E, Sutter R, Curt A, Freund P. Tissue bridges predict recovery after traumatic and ischemic thoracic spinal cord injury. *Neurology*. Oct 15 2019;93(16):e1550-e1560. doi:10.1212/WNL.00000000000008318
- Pfytter D, Vallotton K, Curt A, Freund P. Tissue bridges predict neuropathic pain emergence after spinal cord injury. *J Neurosci*. Oct 2020;40(41):11111-11117. doi:10.1523/JNEUROSCI.0202-20.2020
- Pfytter D, Vallotton K, Curt A, Freund P. Predictive Value of Midsagittal Tissue Bridges on Functional Recovery After Spinal Cord Injury. *Neurorehabil Neural Repair*. Jan 2021;35(1):33-43. doi:10.1177/1545968320971787
- Smith AC, Angel KA, Ugalde-Rosales B, et al. Spinal cord imaging markers and recovery of standing with epidural stimulation in individuals with clinically motor complete spinal cord injury. *Exp Brain Res*. Jan 2022;240(1):279-288. doi:10.1007/s00221-021-06272-9
- Smith AC, O'Dell DR, Thornton WA, et al. Spinal Cord Tissue Bridges Validation Study: Predictive Relationships With Sensory Scores Following Cervical Spinal Cord Injury. *Topics in Spinal Cord Injury Rehabilitation*. 2021.
- Smith AC, O'Dell DR, Thornton WA, et al. Spinal Cord Tissue Bridges Validation Study: Predictive Relationships With Sensory Scores Following Cervical Spinal Cord Injury. *Topics in Spinal Cord Injury Rehabilitation*. 2022;28(2):111-115.
- Vallotton K, Huber E, Sutter R, Curt A, Hupp M, Freund P. Width and neurophysiologic properties of tissue bridges predict recovery after cervical injury. *Neurology*. Jun 11 2019;92(24):e2793-e2802. doi:10.1212/WNL.0000000000000762

Study supported by NIH Eunice Kennedy Shriver National Institute of Child Health and Human Development and the Boettcher Foundation's Webb-Waring Biomedical Research Program.



Scan QR Code for link to published article