Thalamic seed-based functional connectivity within connecting the exclusive cortical regions in routine low frequencies band

We computed group level thalamo-cortical functional connectivity in routine low frequencies band (0.01–0.10 Hz or 0.01-0.073 Hz) in the same manner as for the slow-4 or slow-5 bands functional connectivity analysis. The thalamic seed was placed over the entire bilateral thalamus, within seven segments of the thalamus (seven subfields from the FSL template[1] demonstrated in Figure 2f), Pearson's correlation was computed between the preprocessed average time series of the seed and each voxel within seven exclusive cortical regions. The correlation coefficients values were z-transformed with Fisher's r-to-z transformation and were used for subsequent group-level analysis.

Seven exclusive cortical regions (primary motor (M1, Figure 3-i), primary and secondary somatosensory (S1/S2, Figure 3-ii), occipital cortices, prefrontal (PFC, Figure 3-iii), premotor (lateral and medial) (PMC, Figure 3-iv), posterior parietal (PPC), and temporal (Figure 3-v)) were manually outlined on MNI standard T_1-weighted images using anatomical landmarks, as detailed previously.[1, 2]

Statistics analysis

For comparison of thalamic seed-based functional connectivity with the exclusive cortex during resting state, two-sample t-test was used to compare functional connectivity coefficients maps between patients and controls ($P < .05$, AlphaSim corrected). Further, the significantly altered brain areas in the exclusive cortex were used to select the masks to be retained for two-sample t-test compare analysis.

Results

Compared with healthy controls, no region with altered functional connectivity (both in 0.01–0.10 Hz or 0.01-0.073 Hz) was found between the all the thalamic segments and it’s exclusive cortices in the cervical myelopathy group. The differences in t-values and *P*-values of the patient vs healthy controls connectivity coefficients in the low frequencies band (for example 0.01–0.10 Hz) band are listed in Table C.

Table A. Clinical associations of thalamocortical connectivity coefficients (z-values) in slow-5 frequency-band

	Duration of symptoms (month)		JOA score		NDI score		FA values in C2 level		FA values in the most severe level	
	r	*P*	*r*	*P*	*r*	*P*	*r*	*P*	*r*	*P*
Right precentral gyrus	-0.370	0.144	0.226	0.383	-0.334	0.190	-0.073	0.780	-0.299	0.244
Left precentral gyrus	-0.216	0.405	-0.009	0.974	0.100	0.703	0.275	0.286	-0.190	0.466
Left postcentral gyrus	-0.051	0.845	-0.231	0.372	0.006	0.981	-0.248	0.337	-0.138	0.598
Right postcentral gyrus	-0.327	0.200	-0.240	0.353	0.254	0.325	0.383	0.129	-0.360	0.158
Right middle frontal gyrus	0.323	0.206	-0.093	0.722	0.280	0.276	-0.176	0.500	0.264	0.306
Right inferior frontal gyrus	0.040	0.880	0.161	0.538	-0.057	0.829	0.307	0.230	-0.005	0.985
Left superior frontal gyrus/ supplementary motor area	-0.089	0.735	0.021	0.935	-0.249	0.335	0.288	0.262	-0.061	0.815
Right middle temporal pole	-0.029	0.911	-0.291	0.247	0.133	0.610	-0.160	0.540	-0.227	0.382
Right parahippocampa gyrus	-0.206	0.428	0.163	0.533	-0.161	0.537	0.154	0.554	-0.194	0.456

Notes: FA = Fractional Anisotropy; JOA = Japanese Orthopaedic Association; NDI = Neck Disability Index

Table B. Clinical associations of thalamocortical connectivity coefficients (z-values) in slow-4 frequency-band

	Duration of symptoms (month)		JOA score		NDI score		FA values in C2 level		FA values in the most severe level	
	r	*P*	*r*	*P*	*r*	*P*	*r*	*P*	*r*	*P*
Right precentral gyrus	-0.341	0.172	0.115	0.659	-0.041	0.874	0.295	0.251	0.071	0.788
Right postcentral gyrus-1	-0.143	0.584	0.128	0.623	0.061	0.851	0.607	0.010 (0.013) *	0.470	0.057
Right postcentral gyrus-2	-0.464	0.061	-0.139	0.594	0.171	0.511	0.410	0.102	0.181	0.487
Left postcentral gyrus	-0.533	0.028 (0.132) *	-0.192	0.461	0.091	0.727	-0.008	0.976	0.209	0.420
Right postcentral gyrus-3	-0.440	0.077	0.099	0.705	-0.064	0.808	0.504	0.039 (0.009) *	0.502	0.040 (0.232) *
Right superior/ middle frontal gyrus	-0.196	0.452	-0.205	0.429	0.381	0.131	0.061	0.815	0.332	0.192
Left superior frontal gyrus	0.057	0.827	0.193	0.458	-0.185	0.478	-0.325	0.203	0.021	0.935
Right superior frontal gyrus	0.016	0.952	-0.408	0.104	0.461	0.064	-0.211	0.415	0.109	0.676
Right middle frontal gyrus	0.163	0.533	-0.082	0.754	0.282	0.273	0.620	0.008 (0.004) *	0.550	0.022 (0.002) *
Right superior frontal gyrus	-0.040	0.878	-0.261	0.312	0.216	0.406	0.214	0.409	0.204	0.431
Left superior temporal gyrus	-0.249	0.335	-0.089	0.1734	0.062	0.813	-0.183	0.482	-0.481	0.051

*Notes: FA = Fractional Anisotropy; JOA = Japanese Orthopaedic Association; NDI = Neck Disability Index; * = with post-hoc correction*

Table C The cervical myelopathy patients compared with the controls in low frequencies band (0.01–0.10 Hz), the altered functional connectivity in slow-4 and slow-5 bands as mask

	The mask form slow-4 altered cortex areas	*t-value*	*p-value*	*The mask form slow-5 altered cortex areas*	*t-value*	*p-value*
Primary motor cortex	*Right Precentral Gyrus*	1.227	0.229	*Left Precentral Gyrus*	0.497	0.623
				Right Precentral Gyrus	0.196	0.846
Primary and secondary somatosensory	*Right Postcentral Gyrus-1*	1.485	0.147	*Left Postcentral Gyrus*	-0.751	0.458
	Right Postcentral Gyrus-2	1.360	0.183	*Right Postcentral Gyrus*	-1.649	0.109
	Right Postcentral Gyrus-3	1.718	0.095			
	Left Postcentral Gyrus	1.495	0.145			
Prefrontal	*Right Superior/ Middle Frontal Gyrus*	1.344	0.188	*Right Middle Frontal Gyrus*	1.247	0.221
	Right Superior Frontal Gyrus	1.352	0.186			
	Left Superior Frontal Gyrus	1.993	0.055			
Premotor	*Right Superior Frontal Gyrus*	0.958	0.345	*Right Inferior Frontal Gyrus*	-1.954	0.059
	Right Middle Frontal Gyrus	1.687	0.101	*Left Superior Frontal Gyrus/ Supplementary Motor Area*	-1.847	0.074
Temporal	*Left Superior Temporal Gyrus*	1.246	0.222	*Right Middle Temporal Pole*	-1.532	0.135
				Right Parahippocampa Gyrus	-1.847	0.074

Notes：BA = Brodmann area; MNI = Montreal neurological institute

Reference

1. Behrens T, Johansen-Berg H, Woolrich M, et al. Non-invasive mapping of connections between human thalamus and cortex using diffusion imaging. Nat Neurosci. 2003;6: 750-757.
2. Johansen-Berg H, Behrens TE, Sillery E, et al. Functional-anatomical validation and individual variation of diffusion tractography-based segmentation of the human thalamus. Cereb Cortex. 2005;15: 31-39.