

Thalamo frontal connectivity

Positron emission tomography (PET) techniques represent a useful tool to better understand the residual brain function in vegetative state patients. It has been shown that overall cerebral metabolic rates for glucose are massively reduced in this condition. However, the recovery of consciousness from vegetative state is not always associated with substantial changes in global metabolism. This finding led us to hypothesize that some vegetative patients are unconscious not just because of a global loss of neuronal function, but rather due to an altered activity in some critical brain regions and to the abolished functional connections between them. We used voxel-based Statistical Parametric Mapping (SPM) approaches to characterize the functional neuroanatomy of the vegetative state. The most dysfunctional brain regions were bilateral frontal and parieto-temporal associative cortices. Despite the metabolic impairment, external stimulation still induced a significant neuronal activation (i.e., change in blood flow) in vegetative patients as shown by both auditory click stimuli and noxious somatosensory stimuli. However, this activation was limited to primary cortices and dissociated from higher-order associative cortices, thought to be necessary for conscious perception. Finally, we demonstrated that vegetative patients have impaired functional connections between distant cortical areas and between the thalami and the cortex and, more importantly, that recovery of consciousness is paralleled by a restoration of this cortico-thalamo-cortical interaction ¹⁾.

In 2000, a landmark case report described the concurrent restoration of consciousness and thalamo-frontal connectivity after severe brain injury (Laureys et al.,). Being a single case however, this study could not disambiguate whether the result was specific to the restoration of consciousness per se as opposed to the return of complex cognitive function in general or simply the temporal evolution of post-injury pathophysiological events. To test whether the restoration of thalamo-cortical connectivity is specific to consciousness, 20 moderate-to-severe brain injury patients (from a recruited sample of 42) underwent resting-state functional magnetic resonance imaging within a week after injury and again six months later. As described in the single case report, we find thalamo-frontal connectivity to be increased at the chronic, compared with the acute, time-point. The increased connectivity was independent of whether patients had already recovered consciousness prior to the first assessment or whether they recovered consciousness in-between the two. Conversely, we did find an association between restoration of thalamo-frontal connectivity and the return of complex cognitive function. While we did replicate the findings of Laureys et al. (), our data suggests that the restoration of thalamo-frontal connectivity is not as tightly linked to the reemergence of consciousness per se. However, the degree to which the return of connectivity is linked to the return of complex cognitive function, or to the evolution of other time-dependent post-injury mechanisms, remains to be understood ²⁾.

The dissociation between overt behavior observable in clinical assessments and residual cognitive faculties is prevalent among disorders of [consciousness](#) (DOC) patients (37%). A substantial number of patients, including some diagnosed with [vegetative state](#) (VS), can demonstrate willful engagement in top-down cognition. While neuroimaging data are not the same as observable behavior, this suggests that the mental status of some VS patients exceeds what can be appreciated clinically. Furthermore, thalamo-frontal circuits might be crucial to sustaining top-down functions ³⁾.

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