

# The Role of Imaging Modalities in the Diagnosis of Post-Traumatic Stress Disorder (PTSD)

## Introduction

PTSD develops following an exposure to a traumatic event. Common symptoms include flashbacks, anxiety, and nightmares. Diagnosis mainly depends on self-reports and clinical interviews. Neuroimaging methods (MRI, PET, SPECT, EEG) show changes in the brain linked to PTSD. These changes include a smaller hippocampus, overactive amygdala, and reduced prefrontal cortex function. These findings have advanced the understanding of PTSD.

## Symptoms of PTSD

- Stressor
- Re-experiencing the trauma
- Avoidance of people, places, or thoughts related to the trauma
- Negative thoughts and feelings
- More alert or easily startled

These symptoms must persist for at least one month following the trauma and cause significant distress to daily life.<sup>1</sup>

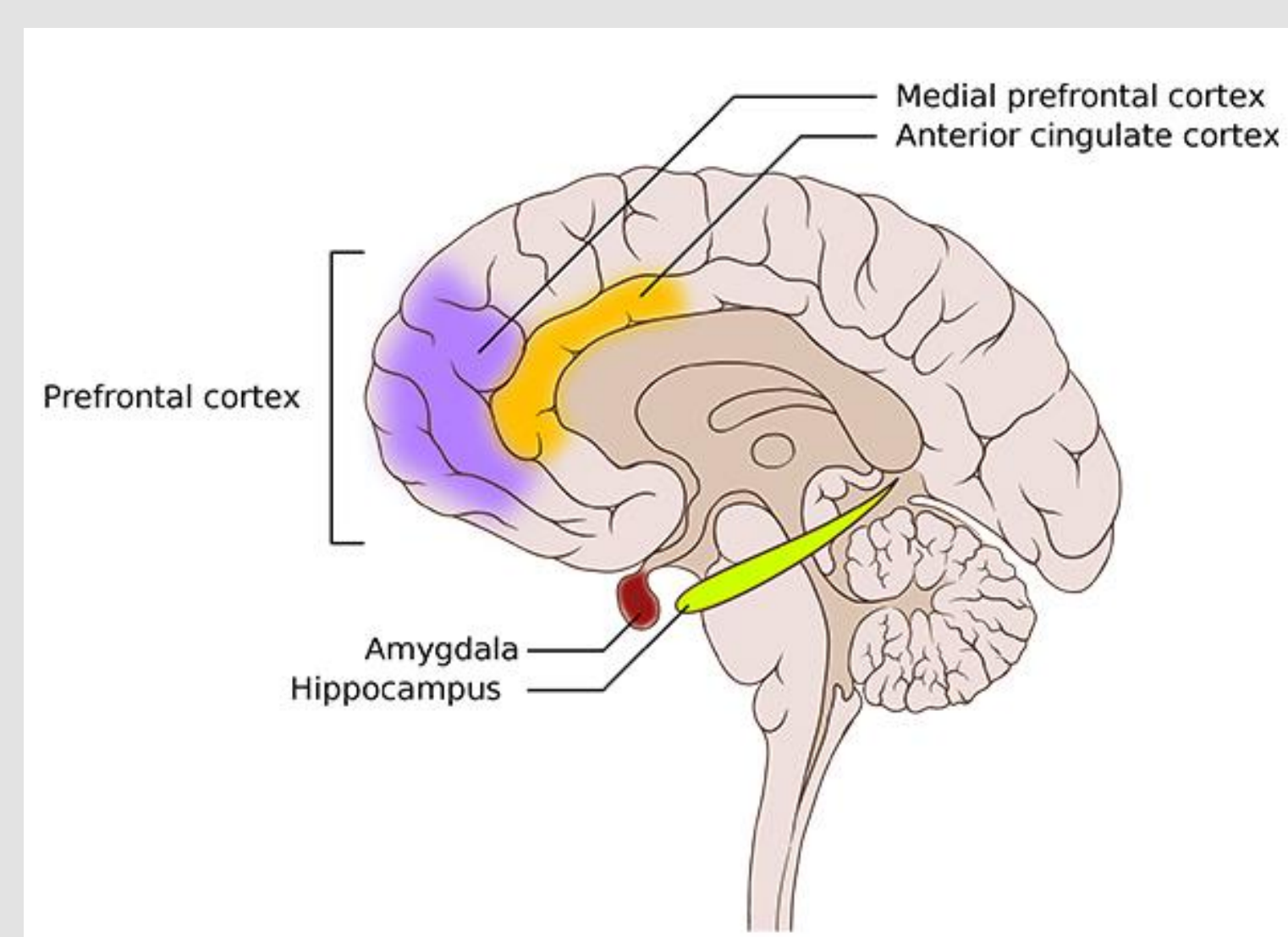


Figure 1. Shows the location of the prefrontal cortex, medial prefrontal cortex, anterior cingulate cortex, amygdala, and hippocampus in the brain.<sup>2</sup>

## Diagnosis

### Amygdala

- Detects threats and generates emotional responses, especially fear.
- PTSD: SPECT often shows hyperactivity<sup>3</sup>
  - Responds too strongly to trauma-related triggers<sup>4</sup>

### Hippocampus

- Forms and retrieves contextual memories
- PTSD: MRI can be used to measure this region<sup>3</sup>
  - Smaller hippocampal volumes<sup>4</sup>
  - Hard to distinguish what is safe

### Prefrontal cortex

- Decision-making and emotional regulation
- PTSD: PET scans have been used to show reduced activity and weakened connectivity with the amygdala<sup>3</sup>
  - Stronger fear reactions

### Anterior cingulate cortex

- Emotional regulation
- PTSD: MRI can often show reduced volume, and fMRI can detect decreased activity<sup>3</sup>
  - Harder for the brain to manage emotions<sup>3</sup>

### Insula

- Processes emotions, body awareness, and internal sensations
- PTSD: increases activity
  - Intense emotional and physical reactions

## Neuroimaging

- **MRI:** 3D, high contrast images
- **fMRI:** blood oxygen level contrast, shows brain activity
- **PET:** radioactive tracers to measure neurotransmitter activity
- **SPECT:** measures cerebral blood flow
- **EEG:** measures brain's electrical activity

## Treatments

- **Cognitive therapy:** focuses on identifying and changing unhelpful thoughts related to the traumatic event<sup>5</sup>
- **Exposure therapy:** patients face memories, thoughts, and situations related to their trauma<sup>5</sup>
- **Selective serotonin reuptake inhibitors (SSRI):** increasing the amount of serotonin<sup>5</sup>
  - Paroxetine
  - Sertraline

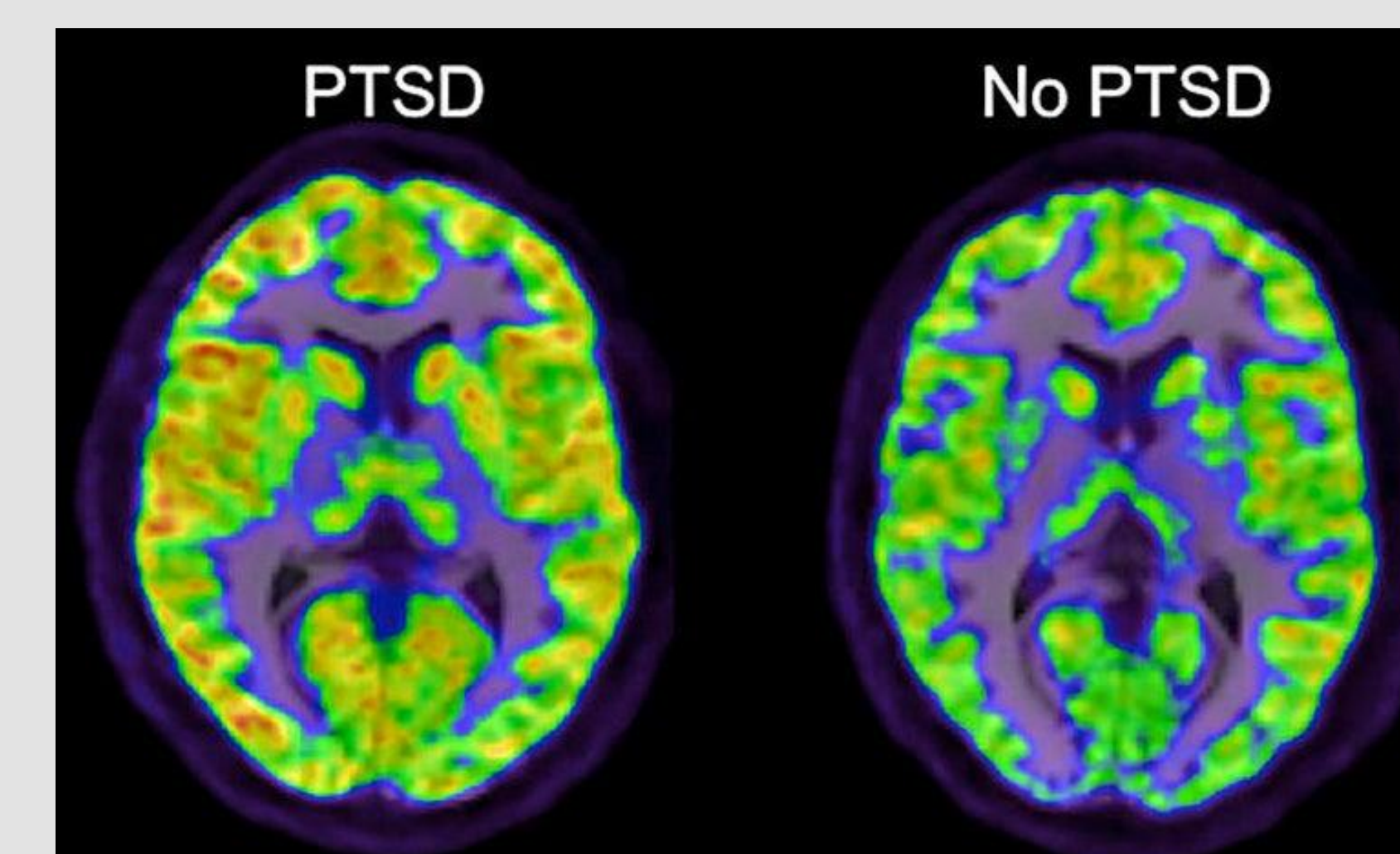


Figure 2. PET images showing higher receptor availability in an individual with PTSD vs. a normal individual<sup>6</sup>

## Conclusion

PTSD is a complex mental health condition that develops after exposure to traumatic events such as violence, abuse, or serious accidents, leading to significant emotional, behavioral, and cognitive changes. Neuroimaging research shows that PTSD is associated with structural and functional alterations in key brain regions, including the amygdala, hippocampus, prefrontal cortex, anterior cingulate cortex, and insula, which contribute to symptoms like fear, hyperarousal, and emotional dysregulation. Diagnosis is based on DSM-5 criteria, but imaging techniques like CT, MRI, PET, SPECT, and EEG have enhanced understanding of the disorder by revealing patterns of brain changes. Treatment typically combines therapies and SSRIs to manage symptoms. Overall, integrating neuroimaging provides further understanding of PTSD and supports the development of more effective, individualized approaches to care.

## Acknowledgements

1. Hinojosa CA, George GC, Ben-Zion Z. Neuroimaging of posttraumatic stress disorder in adults and youth: progress over the last decade on three leading questions of the field. *Mol Psychiatry*. 2024;29(10):3223-3244. <https://doi.org/10.1038/s41380-024-02558-w>
2. Psychiatrists DZIO. Ptsd examined: the five types of post traumatic stress disorder. *Online Psychiatrists*. <https://www.onlinepsychiatrists.com/ptsd-examined-the-five-types-of-post-traumatic-stress-disorder>
3. Zhang H, Hu Y, Yu Y, et al. The value of multimodal neuroimaging in the diagnosis and treatment of post-traumatic stress disorder: a narrative review. *Transl Psychiatry*. 2025;15(1):1-12. <https://doi.org/10.1038/s41398-025-03416-1>
4. Henigsberg N, Kalember P, Petrović ZK, Šečić A. Neuroimaging research in posttraumatic stress disorder – focus on amygdala, hippocampus and prefrontal cortex. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*. 2019;90:37-42. <https://doi.org/10.1016/j.pnpb.2018.11.003>
5. Schrader C, Ross A. A review of ptsd and current treatment strategies. *Missouri Medicine*. 2021;118(6):546. <https://pmc.ncbi.nlm.nih.gov/articles/PMC8672952/>
6. Hathaway B. New PTSD study identifies potential path to treatment. *YaleNews*. Published July 17, 2017. <https://news.yale.edu/2017/07/17/new-ptsd-study-identifies-potential-path-treatment>