

# NEUROMODULATION



## Types of Neuromodulation to Treat Seizures

- VNS (Vagus Nerve Stimulation)
- RNS Therapy (Responsive Neurostimulation)
- DBS Therapy (Deep Brain Stimulation)

## What is Neuromodulation?

Neuromodulation is a type of technology that acts directly upon nerves. A device is implanted in a person and it delivers electrical impulses to alter nerve activity. The most common types of neuromodulation used in LGS are Vagus Nerve Stimulation (VNS), Responsive Neurostimulation (RNS), and Deep Brain Stimulation (DBS). All of these require some type of surgery to implant the device.

## What is Vagus Nerve Stimulation (VNS)?

How does the brain control heart rate, digestion, sweating, speech, chewing, and the gag reflex? Though these functions seem unrelated, they're all controlled by the vagus nerve – a long fiber that connects the brain to the throat, heart, and digestive system.

Stimulating this nerve — using an implanted device that controls the vagus nerve much like an artificial pacemaker controls the heart — can suppress seizures after they start and can reduce seizure frequency by 45 to 80 percent. VNS devices stimulate this nerve by sending mild electrical impulses to it, which are then carried up to the brain to the areas where seizures begin. This technique, known as vagal nerve stimulation (VNS), is most effective in people with atonic and focal seizures. The device tends to be least effective in individuals who experience generalized tonic-clonic and complex partial seizures.



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## What is Responsive Neurostimulation (RNS)?

In responsive neurostimulation, a small battery-powered device called a neurostimulator is implanted in the patient's skull. The neurostimulator is connected to thin wires, called leads, which the surgeon places in the area or areas of the brain where the patient's seizures originate. The neurostimulator monitors the brain's electrical activity. When brain activity that could lead to a seizure is detected, the neurostimulator delivers a pulse of electrical stimulation through the leads. The electrical pulse may stop the seizure before it begins.



## What is Deep Brain Stimulation (DBS)?

DBS is an FDA-approved seizure treatment that stimulates deep brain structures with an implanted neurostimulator device. The device is implanted during brain surgery.

Common areas targeted by DBS include:

- Centromedian nucleus of the thalamus (CM) stimulation is more effective for patients with generalized epilepsy than focal epilepsy. This procedure can reduce seizures by 70-80 percent in people with tonic-clonic and absence seizures, but outcomes are harder to predict in people with focal seizures or frontal lobe epilepsy.
- Anterior nucleus of the thalamus (ANT) stimulation can control seizures that begin in the temporal lobe, and the effects are relatively long-lasting. Some people experience depression and memory impairment after ANT stimulation, however. This procedure has been approved for use in Europe, but not the United States.
- Hippocampal deep brain stimulation can reduce seizure frequency by 50-60 percent in people with temporal lobe epilepsy. People with normal MRI findings have better seizure outcomes after this type of stimulation than those with hippocampal injuries. Benefits are greatest when both, rather than one, side of the hippocampus are stimulated. Memory decline has not been reported.



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