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PATIENT GUIDE

Surgical options for epilepsy: my guide for patients

Who should consider surgery for epilepsy, what the evaluation looks like, and how the surgical options compare.

AT A GLANCE

First step	Anti-seizure medications
Consider surgery	If seizures continue to affect your life after two or more medications
Evaluation	Seizure symptoms, video EEG, MRI and PET, cognitive testing, and sometimes SEEG
Partial onset	Craniotomy or laser ablation, which offer a chance at a cure, or RNS, DBS, and VNS when the area cannot be removed
Generalized	Neuromodulation, including centromedian RNS for select patients
Deciding	With me, your neurologist, and your family, using our epilepsy surgery committee's recommendation

This information is intended as a general guide for my patients, and if you are seeing a different neurosurgeon, it should not substitute for advice, guidance, or instructions from that surgeon.

Introduction

A seizure is a storm of abnormal electrical activity in the brain. Seizures can cause a variety of symptoms depending on the part of the brain affected: tingling, weakness, confusion or a blank stare, jerking of the arms or legs, or even a convulsion of the entire body.

Epilepsy is a neurologic disorder in which a patient has recurrent seizures. Epilepsy can strike at any age, and it is relatively common: 1 in 26 people is affected at some point in

life. There are many causes for epilepsy, ranging from head injury to brain tumors to autoimmune disease. In many patients, no obvious cause is identified.

Treatment for epilepsy usually starts with medications. For patients who continue to have seizures despite medications, there are a number of effective surgical options, outlined below.

What are the benefits of epilepsy surgery?

Uncontrolled seizures can have a variety of effects on a person's life: difficulty maintaining employment or a driver's license, social stigma, side effects from medications, and disruptive changes in thinking and memory. Patients with seizures are also at risk of sudden death, a catastrophic event known as *SUDEP*.

Clinical trials have established several benefits of surgery for epilepsy:

- Fewer seizures (some surgeries can even permanently cure epilepsy).
- Reducing or eliminating the need for anti-seizure medications.
- Improved thinking and memory (certain procedures).
- Better quality of life.
- Lower risk of SUDEP.

Who should consider surgery for epilepsy?

You should consider surgery for epilepsy if you continue to have seizures that affect your life after you have tried two or more anti-seizure medications.

What does the evaluation for epilepsy surgery look like?

The first step is determining whether you have *partial onset* (also known as *focal*) or *generalized* epilepsy.

Partial onset epilepsy

In patients with partial onset epilepsy, seizures start in one or several parts of the brain and then spread. Various tests are used to help pinpoint the diseased part(s) of the brain causing the seizures: your seizure symptoms, a videotaped EEG study, scans of your brain (e.g. MRI and PET), and detailed cognitive testing, among others. In some cases, a special test known as SEEG may be needed. Once the diseased part(s) of the brain have been identified, I conduct a detailed conference about your epilepsy with a committee of doctors (neurologists, radiologists, and neuropsychologists) to discuss options for surgery.

Generalized epilepsy

In patients with generalized epilepsy, the whole brain is prone to seizures. There is no one spot that can be pinpointed as the cause. For treatment, rather than remove part of the brain, we use therapies that apply electrical impulses to prevent seizures (see below).

How do you tell the difference?

We use seizure symptoms and an EEG to determine whether you have partial onset or generalized epilepsy. Importantly, having generalized tonic clonic (grand mal) seizures does not necessarily mean you have generalized epilepsy.

What are the surgical options for partial onset epilepsy?

After identifying the part of your brain that is causing seizures, I next evaluate whether that area can be safely removed. If so, treatment options include opening the skull to remove the diseased brain tissue (known as a craniotomy) and burning the tissue with a minimally invasive laser. Both of these procedures offer a chance at a cure.

In some cases, the brain tissue causing seizures is also critical for normal functions like vision, speech, movement, or memory. Removing or burning this tissue is therefore not an option, and I instead focus on neuromodulation therapies that interrupt or prevent seizures with pulses of electricity: RNS, DBS, and VNS. While these therapies have a number of benefits (see below), they usually cannot offer a complete cure.

Responsive neurostimulation (RNS)

Responsive neurostimulation (RNS; also known as NeuroPace) involves inserting one or two wires into the brain and connecting them to a tiny computer embedded in the skull. The system continually monitors the brain for seizures and then automatically delivers a painless, imperceptible pulse of electricity to interrupt them.

Deep brain stimulation (DBS)

Deep brain stimulation (DBS) involves inserting two wires into a part of the brain known as the anterior nucleus of the thalamus. These wires are connected to a pacemaker inserted under the collarbone. DBS delivers imperceptible pulses of electricity every few minutes, and these pulses have been shown to reduce the frequency of seizures.

Vagus nerve stimulation (VNS)

Vagus nerve stimulation (VNS) is similar to the above therapies, except the wire delivering the electrical pulses is implanted onto a nerve in the neck rather than inside the brain. VNS, like DBS, delivers pulses every few minutes, and it also has a mode that listens for changes in heart rate that might signal the onset of a seizure.

What are the surgical options for generalized epilepsy?

In most cases, craniotomy, laser ablation, and DBS are *not* appropriate options for patients with generalized epilepsy. Historically, VNS has been the primary option available, although it remains off-label according to the FDA. It is also the least effective of the available surgeries for epilepsy, and in my experience it tends to have the most side effects.

Recently, however, studies have suggested that RNS can be particularly effective for patients with generalized epilepsy when implanted in a part of the brain known as the

centromedian thalamus. This is an exciting development for the epilepsy community, and additional clinical trials are under way to study this further. I am currently offering centromedian RNS to select patients with generalized epilepsy.

What are the advantages and disadvantages of the neuromodulation procedures?

Below is a comparison of key features:

	RNS (NeuroPace)	DBS	VNS
Average long-term seizure reduction	~80-85%	~75%	~50%
Offers automatic long-term monitoring of seizures?	Yes	No	No
Hospital stay required for surgery?	Yes (1-2 nights)	Yes (1 night)	No
Long-term side effects	Uncommon	Possible depression, memory impairment	Possible hoarseness, voice changes, cough
Location of battery	Embedded in skull	Under collarbone	Under collarbone
Insurance coverage	All insurance carriers	All insurance carriers	Some restrictions by United Healthcare
Other notes	Requires wireless data uploads		

How do I decide which procedure is right for me?

Most patients will have more than one surgical option. I will present your options along with our epilepsy surgery committee's recommendation(s) during your office visit. Deciding between your options requires a careful discussion with me, your neurologist, and your family regarding your particular epilepsy along with surgical risks and your goals. In most cases, having one procedure performed does not prevent a different procedure from being performed in the future, if needed.

Where can I learn more?

My website is an excellent resource for patients wanting to learn more about epilepsy and the procedures reviewed above. Here is a list of relevant pages from the site:

- Epilepsy
- SEEG
- Craniotomy for epilepsy
- Temporal lobectomy
- RNS (NeuroPace)
- DBS
- VNS
- Laser ablation

If you live near Denver and have epilepsy that has not responded to medications, please consider meeting me in consultation to learn about your treatment options.