



Tremor

U.S. DEPARTMENT OF HEALTH
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Tremor

What is tremor?

A tremor is an involuntary, rhythmic muscle contraction leading to shaking movements in one or more parts of the body. It is a common movement disorder that most often affects the hands but can also occur in the arms, head, vocal cords, torso, and legs. Tremor may be intermittent (occurring at separate times, with breaks) or constant. It can occur sporadically (on its own) or happen as a result of another disorder.

Tremor is most common among middle-aged and older adults, although it can occur at any age. The disorder generally affects men and women equally.

Tremor is not life threatening. However, it can be embarrassing and even disabling, making it difficult or even impossible to perform work and daily life tasks.

What causes tremor?

Generally, tremor is caused by a problem in the deep parts of the brain that control movements. Most types of tremor have no known cause, although there are some forms that appear to be inherited and run in families (called familial).

Tremor can occur on its own or be a symptom associated with a number of neurological disorders, including:

- multiple sclerosis
- stroke
- traumatic brain injury
- neurodegenerative diseases that affect parts of the brain (e.g., Parkinson's disease).

Other known causes can include:

- the use of certain medicines (particular asthma medication, amphetamines, caffeine, corticosteroids, and drugs used for certain psychiatric and neurological disorders)
- alcohol use disorder or withdrawal
- mercury poisoning
- overactive thyroid
- liver or kidney failure
- anxiety or panic.

Some tremor may be triggered by or become worse during times of stress or strong emotion, when an individual is physically exhausted, or when a person is in certain postures or makes certain movements.

What are the symptoms of tremor?

Symptoms of tremor may include:

- a rhythmic shaking in the hands, arms, head, legs, or torso
- shaky voice
- difficulty writing or drawing
- problems holding and controlling utensils, such as a spoon.

How is tremor classified?

Tremor can be classified into two main categories:

Resting tremor occurs when the muscle is relaxed, such as when the hands are resting on the lap. A person's hands, arms, or legs may shake even when they are at rest. Often, the tremor only affects the hand or fingers. This type of tremor is often seen in people with Parkinson's disease.

Action tremor occurs with the voluntary (intended) movement of a muscle. Most types of tremor are considered action tremor. There are several sub-classifications of action tremor, many of which overlap.

- **Postural tremor** occurs when a person maintains a position against gravity, such as holding the arms outstretched.
- **Kinetic** tremor is associated with any voluntary movement, such as moving the wrists up and down or closing and opening the eyes.
- **Intention tremor** is produced with purposeful movement toward a target, such as lifting a finger to touch the nose. Typically, the tremor will become worse as an individual gets closer to their target.
- **Task-specific tremor** only appears when performing highly skilled, goal-oriented tasks such as handwriting or speaking.
- **Isometric tremor** occurs during a voluntary muscle contraction that is not accompanied by any movement such as holding a heavy book or a dumbbell in the same position.

What are the different categories or types of tremor?

Tremor is most commonly classified by its appearance and cause or origin. There are more than 20 types of tremor. Some of the most common forms of tremor include:

Essential tremor

Essential tremor (also called benign essential tremor or familial tremor) is one of the most common movement disorders. For some people this tremor is mild and remains stable for many years. The tremor usually appears on both sides of the body but is often noticed more in the dominant hand because it is action tremor.

It occurs in both hands and arms and is present during action and when standing still. Additional symptoms may include head tremor and a shaking or quivering sound to the voice if the voice box is affected. Essential tremor can lead to problems with writing, drawing, drinking from a cup, or using tools or a computer.

Tremor frequency (how “fast” the tremor shakes) may decrease with age, but the severity may increase, affecting daily life. Heightened emotion, stress, fever, physical exhaustion, or low blood sugar may trigger tremor and/or increase severity. Essential tremor most often appears for the first time during adolescence or in middle age (between ages 40 and 50). Small amounts of alcohol may help decrease essential tremor, but the mechanism behind this is unknown.

The exact cause of essential tremor is unknown. About half of essential tremor cases are thought to be caused by a genetic risk factor (referred to as familial tremor). Children of a parent who has familial tremor have a greater risk of inheriting the condition. Familial forms of essential tremor often appear early in life.

Dystonic tremor

Dystonic tremor occurs in people who are affected by *dystonia*—a movement disorder where incorrect messages from the brain cause muscles to be overactive, resulting in abnormal postures or sustained, unwanted movements. Dystonic tremor usually appears in young or middle-aged adults and can affect any muscle in the body. Symptoms may sometimes be relieved by complete relaxation.

Although some of the symptoms are similar, dystonic tremor differs from essential tremor in some ways. Dystonic tremor:

- is associated with abnormal body postures due to forceful muscle spasms or cramps
- can affect the same parts of the body as essential tremor, but dystonic tremor can affect the head—more so than essential tremor—without any other movement in the hands or arms
- can also mimic resting tremor, such as the one seen in Parkinson's disease.

The severity of dystonic tremor may be reduced by touching the affected body part or muscle, and tremor movements are “jerky” or irregular instead of rhythmic.

Parkinsonian tremor

Parkinsonian tremor is a common symptom of Parkinson's disease, although not all people with Parkinson's disease have tremor. Generally, symptoms include shaking in one or both hands at rest. It may also affect the chin, lips, face, and legs. The tremor may initially appear in only one limb or on just one side of the body. As the disease progresses, it may spread to both sides of the body. The tremor is often made worse by stress or strong emotions. More than 25 percent of people with Parkinson's disease also have an associated action tremor.

Cerebellar tremor

Cerebellar tremor is typically a slow, high-amplitude (easily visible) tremor of the extremities (e.g., arm, leg) that occurs at the end of a purposeful movement such as trying to press a button. It is caused by damage to the cerebellum and its connections to other brain regions resulting from a stroke or tumor. Damage also may be caused by disease such as multiple sclerosis or an inherited degenerative disorder such as *ataxia* (in which people lose muscle control in the arms and legs) and *Fragile X syndrome* (a disorder marked by a range of intellectual and developmental problems). It can also result from chronic damage to the cerebellum due to alcoholism.

Psychogenic tremor

Psychogenic tremor (also called functional tremor) can appear as any form of tremor. Its symptoms may vary but often start abruptly and may affect all body parts. The tremor increases in times of stress and decreases or

disappears when distracted. Many individuals with psychogenic tremor have an underlying psychiatric disorder such as depression or post-traumatic stress disorder (PTSD).

Physiologic tremor

Physiologic tremor can occur in any healthy individual. It is rarely visible to the eye and typically involves a fine shaking of both of the hands and also the fingers. It is not considered a disease but is a normal human phenomenon that is the result of physical properties in the body (for example, rhythmical activities such as heartbeat and muscle activation).

Enhanced physiologic tremor

Enhanced physiological tremor is a more noticeable case of physiologic tremor that can be easily seen. It is generally caused by reaction to certain drugs, alcohol withdrawal, or medical conditions including an overactive thyroid and hypoglycemia. It is usually reversible once the cause is corrected.

Orthostatic tremor

Orthostatic tremor is a rare disorder characterized by rapid muscle contractions in the legs that occur when standing. People typically experience feelings of unsteadiness or imbalance, causing them to immediately attempt to sit or walk. Because the tremor has such a high frequency (very fast shaking) it may not be visible to the naked eye but can be felt by touching the thighs or calves or can be detected by a doctor examining the muscles with a stethoscope. In some individuals the tremor can become more severe over time. The cause of orthostatic tremor is unknown.

How is tremor diagnosed?

Tremor is diagnosed based on a physical and neurological examination and an individual's medical history. During the physical evaluation, a doctor will assess the tremor based on:

- whether the tremor occurs when the muscles are at rest or in action
- the location of the tremor on the body (and if it occurs on one or both sides of the body)
- the appearance of the tremor (tremor frequency and amplitude)

other neurological findings such as impaired balance, speech abnormalities, or increased muscle stiffness.

Additional tests may include:

- blood or urine tests to rule out metabolic causes, certain medications that can cause tremor, or identify contributing causes such as drug interactions, chronic alcoholism, or other conditions or diseases.
- diagnostic imaging may help determine if the tremor is the result of damage in the brain
- assessment of functional limitations such as difficulty with handwriting
- tasks or exercises such as placing a finger on the tip of their nose or drawing a spiral
- an electromyogram, which measures involuntary muscle activity and muscle response to nerve stimulation, to diagnose muscle or nerve problems.

How is tremor treated?

There is no cure for most forms of tremor, but treatment options are available to help manage symptoms. In some cases, a person's symptoms may be mild enough that they do not require treatment.

Finding an appropriate treatment depends on an accurate diagnosis of the cause. Tremor caused by underlying health problems can sometimes be improved or eliminated entirely with treatment. For example, tremor due to thyroid hyperactivity will improve or even return to the normal state with treatment of thyroid malfunction. Also, if tremor is caused by medication, discontinuing the tremor-causing drug may reduce or eliminate this tremor.

If there is no underlying cause for tremor that can be modified, treatment options include:

Medication

- **Beta-blocking drugs** such as propranolol (normally used to treat high blood pressure) can treat essential tremor, as well as in some people with other types of action tremor. Other beta-blockers that may be used include atenolol, metoprolol, nadolol and sotalol.
- **Anti-seizure medications** such as primidone can be effective in people with essential tremor who do not respond to beta blockers. Other medications that may be prescribed include gabapentin and topiramate. However, it is important to note that some anti-seizure medications can cause tremor.
- **Tranquilizers (also known as benzodiazepines)** such as alprazolam and clonazepam may temporarily help some

people with tremor. However, their use is limited due to unwanted side effects that include sleepiness, poor concentration, ability to perform some activities of daily living, physical dependence, and poor coordination.

- **Parkinson's disease medications** (levodopa, carbidopa) are used to treat tremor associated with Parkinson's disease.
- **Botulinum toxin** injections can treat almost all types of tremor. It is widely used to control dystonic tremor and especially useful for head tremor, which generally does not respond to medications. Although botulinum toxin injections can improve tremor for roughly three months at a time, they can also cause muscle weakness and weakness in the fingers. It can cause a hoarse voice and difficulty swallowing when used to treat voice tremor.

Ultrasound

This treatment for essential tremor uses magnetic resonance images to deliver focused ultrasound to tiny areas of the thalamus (an area of the brain involved with relaying sensory and movement signals) thought to be responsible for causing the tremors. The treatment is approved only for those individuals with essential tremor who do not respond well to anti-seizure or beta-blocking drugs.

Surgery

When people do not respond to drug therapies or have a severe tremor that significantly impacts their daily life, a doctor may recommend surgical interventions such as deep brain stimulation (DBS) or very rarely, thalamotomy. While DBS is usually well tolerated, the most common side

effects of tremor surgery include dysarthria (trouble speaking) and balance problems.

- **Deep brain stimulation (DBS)** is the most common form of surgical treatment for parkinsonian tremor, essential tremor, and dystonia. DBS is effective, has low risk, and treats a broader range of symptoms than thalamotomy. Surgically implanted electrodes send high-frequency electrical signals to the thalamus, the deep structure of the brain that coordinates and controls some involuntary movements. A small pulse generating device placed under the skin in the upper chest (similar to a pacemaker) sends electrical stimuli to the brain and temporarily disables the tremor.
- **Thalamotomy** involves the precise, permanent destruction of a tiny area in the thalamus. Currently, surgery is replaced by **radiofrequency ablation** to treat severe tremor when deep brain surgery is unwise as a treatment option or has undesirable side effects. Radiofrequency ablation uses a radio wave to generate an electric current that heats up a nerve and disrupts its signaling ability for typically six or more months. It is usually performed on only one side of the brain to improve tremor on the opposite side of the body. Surgery on both sides is not recommended as it can cause problems with speech.

Lifestyle changes

- **Physical therapy** may help people improve their muscle control, functioning, and strength through coordination, balancing, and other exercises. Some physical therapists recommend the use of weights, splints, other adaptive equipment, and special plates and utensils for eating.

- **Eliminating or reducing tremor-inducing substances** (such as caffeine, stimulant medications, and alcohol) can help improve tremor. Although small amounts of alcohol can improve tremor for some people, tremor can become worse once the effects of the alcohol wear off.

What is the prognosis?

Tremor is not considered a life-threatening condition. Although many cases of tremor are mild, tremor can be very disabling. It can be difficult for individuals with tremor to perform normal daily activities such as working, bathing, dressing, and eating. Tremor can also cause “social disability.” People may limit their physical activity, travel, and social engagements to avoid embarrassment or other consequences.

The symptoms of essential tremor usually worsen with age. Additionally, there is some evidence that people with essential tremor are more likely to develop other neurodegenerative conditions such as Parkinson’s disease or Alzheimer’s disease, especially in individuals whose tremor first appears after age 65.

Unlike essential tremor, the symptoms of physiologic and drug-induced tremor do not generally worsen over time and can often be improved or eliminated once the underlying causes are treated.

What research is being done?

The mission of the National Institute of Neurological Disorders and Stroke (NINDS) is to seek fundamental knowledge about the brain and nervous system and to use that knowledge

to reduce the burden of neurological disease. The NINDS is a component of the National Institutes of Health (NIH), the leading supporter of biomedical research in the world.

Researchers are working to better understand the underlying brain functions that cause tremor, identify the genetic factors that make individuals more susceptible to the disorder, and develop new and better treatment options.

Brain functioning

Parkinson's disease and essential tremor have different prognoses and respond very differently to available therapies. NINDS researchers are working to identify structural and functional changes in the brain using non-invasive neuroimaging techniques to develop sensitive and specific markers for each of these diseases and then track how they change as each disease progresses.

Other researchers are using functional magnetic resonance imaging technology (fMRI) to better understand normal and diseased brain circuit functions and associated motor behaviors. Scientists hope to design therapies that can restore normal brain circuit function in diseases such as Parkinson's disease and tremor.

Genetics

Research has shown that essential tremor may have a strong genetic component affecting multiple generations of families. NINDS researchers are working to identify susceptibility genes for early-onset (before age 40) essential tremor by studying multigenerational, early onset families. NINDS scientists are also researching the impact of other genetic abnormalities on the development of essential tremor

Medications and other treatment methods

Many people with essential tremor respond to ethanol (alcohol); however, it is not clear why or how. NINDS researchers are studying the impact of ethanol on tremor to determine the correct dosage amount and its physiological impact on the brain. Other NIH researchers hope to identify the source of essential tremor, study the effects of currently available tremor-suppressant drugs on the brain, and develop more targeted and effective therapies.

While drugs can be effective for some people, approximately 50 percent of individuals with tremor do not respond to medication. In order to develop assistive and rehabilitative tremor-suppressing devices for people with essential tremor, researchers are exploring where and how to minimize or suppress tremor while still allowing for voluntary movements.

Clinical studies

Clinical research is medical research that involves people. Researchers use **observational studies** to collect information from people and compare that data over time, and findings may help researchers identify new treatments or prevention strategies to test in clinical trials.

Clinical trials are a type of research that tests ways and procedures such as new drugs, medical devices, surgery, or behavior and lifestyle changes to detect and diagnose diseases and to better care for those living with diseases.

Clinical research being conducted at NINDS laboratories as well as through NINDS-funded scientists at universities and centers in the U.S. hopes to:

- see how the brain controls movement, note changes in the brain, and identify possible causes of various types of tremor
- determine the physiology and effectiveness of Deep Brain Stimulation (DBS) in treating essential tremor, dystonia, and Parkinson's disease that doesn't respond well to medication
- use transcranial magnetic stimulation, which uses an external magnetic field to stimulate nerve cells in the brain, to compare cortical activity in people with tremor and hopefully result in an improved clinical outcome
- collect clinical outcomes of DBS in people with movement disorders, to make retrospective comparisons and track risks, benefits, and complications
- develop a physiological brain atlas that will allow scientists to significantly improve data collection and analysis to better understand and treat brain disease more precisely
- identify families with inherited movement disorders to investigate and identify underlying molecular and genetic mechanisms and specific disease-causing genes for movement disorders
- determine if DBS stimulation delivered only when necessary to suppress tremor is more effective than continuous stimulation and will cause fewer side effects.

Where can I get more information?

For more information on neurological disorders or research programs funded by the National Institute of Neurological Disorders and

Stroke, contact the Institute's Brain Resources and Information Network (BRAIN) at:

BRAIN

P.O. Box 5801
Bethesda, MD 20824
800-352-9424

More information about tremor research supported by NINDS and other NIH Institutes and Centers can be found using NIH RePORTER, a searchable database of current and past research projects supported by NIH and other federal agencies. RePORTER also includes links to publications and resources from these projects.

Information on tremor also is available from the following organizations:

International Essential Tremor Foundation

P.O. Box 14005
Lenexa, KS 66285-4005
888-387-3667
<https://www.essentialtremor.org/>

HopeNET

14425 Coachway Drive
Centreville, VA 20120
703-543-8131, 804-754-4455
<https://thehopenet.org/blog2/>

National Ataxia Foundation

2600 Fernbrook Lane North, Suite 119
Minneapolis, MN 55447-4752
763-553-0020
<https://www.ataxia.org>

Tremor Action Network

P.O. Box 5013
Pleasanton, CA 94566-5013
510-681-6565
<https://tremoraction.org/>



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