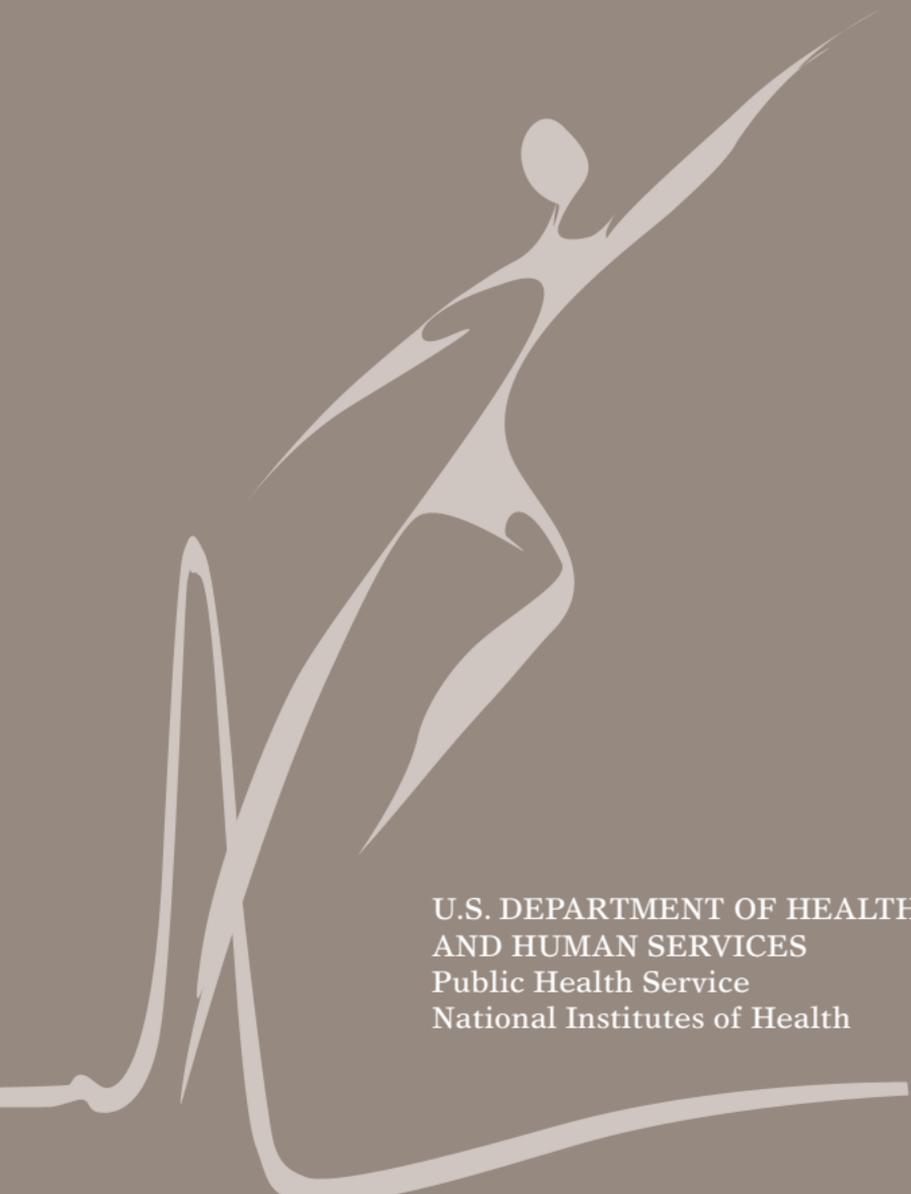


Tremor

A stylized, white graphic of a person with their arms raised in a gesture of triumph or relief. The figure is composed of smooth, flowing lines. This figure is superimposed on a white waveform that resembles an electroencephalogram (EEG) or a similar signal. The waveform starts with a small peak, followed by a sharp, high-amplitude spike, and then a long, low-amplitude tail that tapers off to the right. The background is a solid, muted taupe color.

U.S. DEPARTMENT OF HEALTH
AND HUMAN SERVICES
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Tremor

What is tremor?

Tremor is an unintentional, rhythmic muscle movement involving to-and-fro movements (oscillations) of one or more parts of the body. It is the most common of all involuntary movements and can affect the hands, arms, head, face, voice, trunk, and legs. Most tremors occur in the hands. In some people, tremor is a symptom of a neurological disorder or appears as side effect of certain drugs. The most common form of tremor, however, occurs in otherwise largely healthy people. Although tremor is not life-threatening, it can be embarrassing to some people and make it harder to perform daily tasks.

What causes tremor?

Tremor is usually generated in parts of the brain that control muscles throughout the body or in particular areas, such as the hands. Neurological disorders or conditions that can produce tremor include multiple sclerosis, stroke, traumatic brain injury, and neurodegenerative diseases that damage or destroy parts of the brain stem or the cerebellum. Other causes include the use of some drugs (such as amphetamines, corticosteroids, and drugs used for certain psychiatric disorders), alcohol abuse or withdrawal, mercury poisoning, overactive thyroid, or liver failure. Some forms of tremor are inherited and run in families, while others have no known cause.

What are the characteristics of tremor?

Characteristics may include a rhythmic shaking in the hands, arms, head, legs, or trunk; shaky voice; difficulty writing or drawing; or problems holding and controlling utensils, such as a fork. Some tremors may be triggered by or become exaggerated during times of stress or strong emotion, when the individual is physically exhausted, or during certain postures or movements.

Tremor may occur at any age but is most common in middle-aged and older persons. It may be occasional, temporary, or occur intermittently. Tremor affects men and women equally.

A useful way to understand and describe tremors is to define them by the condition of activation that typically occurs. *Resting tremor* occurs when the muscle is relaxed, such as when the hands are lying on the lap or hanging next to the trunk during standing or walking. It may be seen as a shaking of the hand or limb, even when the person is at rest. Often, the tremor only affects the hand or fingers. This type of tremor is often seen in patients with Parkinson's disease. An *action tremor* occurs during any type of movement of an affected body part. There are several sub-classifications of action tremor. *Postural tremor* occurs when the person maintains a position against gravity, such as holding the arms outstretched. *Kinetic tremor* appears during movement of a body part, such as moving the wrists up and down. *Intention tremor* is present during a purposeful movement toward a target, such as touching a finger to one's nose during a medical exam, typically getting larger and larger toward the goal. *Task-specific tremor* 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.

What are the different categories of tremor?

Tremor is most commonly classified by its appearance and cause or origin. Some of the better-known forms of tremor, with their symptoms, include the following:

Essential tremor (previously also called benign essential tremor) is the most common form of abnormal tremor. Although the tremor may be mild and nonprogressive in some people over a long period of time, in others the tremor is slowly progressive, starting on one side of the body but affecting both sides within a few years. The hands are most often affected, but the head, voice, tongue, legs, and trunk may also be involved, however typically to a lesser extent than the hands. Tremor of the hands is typically an action tremor. Head tremor may be seen as a “yes-yes” or “no-no” motion. Essential tremor may be accompanied by mild gait disturbance. Tremor frequency may decrease as the person ages, but the severity may increase, affecting the person’s ability to perform certain tasks or activities of daily living. Heightened emotion, stress, fever, physical exhaustion, or low blood sugar may trigger tremors and/or increase their severity. Onset is most common after age 40, although symptoms can appear at any age. It may occur in more than one family member. Children of a parent who has familial essential tremor have an approximate 50 percent chance of inheriting the condition. A variant in the gene *LINGO1* has been identified as a risk-gene, although not all people with

essential tremor carry this variant. The gene also can be present in people without essential tremor. While essential tremor was thought not to be associated with any known pathology over many years, recent studies suggest there may be mild degeneration of certain parts of the cerebellum in patients with essential tremor.

Parkinsonian tremor is caused by damage to structures within the brain that control movement. This tremor, which appears typically as resting tremor, can occur as an isolated symptom or be seen in other disorders. It is often the first symptom of Parkinson disease. The tremor is classically seen as a “pill-rolling” action of the hands that may also affect the chin, lips, legs, and trunk. It can be markedly increased by stress or emotions. Onset of parkinsonian tremor is generally after age 60. Movement starts in one limb or on one side of the body and usually progresses to include the other side. In addition to the very characteristic resting tremor, more than 25 percent of those with Parkinson’s disease have an associated action tremor as well.

Dystonic tremor occurs in individuals of all ages who are affected by *dystonia*—a movement disorder in which sustained involuntary muscle contractions cause twisting and repetitive motions and/or painful and abnormal postures or positions, such as involuntary twisting of the neck (torticollis) or writer’s cramp. Dystonic tremor may affect any muscle in the body and is seen most often when the person is in a certain

position or moves a certain way. The pattern of dystonic tremor may differ from essential tremor. Dystonic tremors occur irregularly and often can be relieved by complete rest. Touching the affected body part or muscle may reduce tremor severity. The tremor may be the initial sign of dystonia localized to a particular part of the body.

Cerebellar tremor is a slow, large-amplitude tremor of the extremities that occurs at the end of a purposeful movement (*intention tremor*), such as trying to press a button or touching a finger to the tip of one's nose. Cerebellar tremor is caused by lesions in or damage to the cerebellum resulting from stroke, tumor, or disease such as multiple sclerosis or some inherited degenerative disorder. It can also result from chronic alcoholism or overuse of some medicines. In classic cerebellar tremor, a lesion on one side of the brain produces a tremor in that same side of the body that worsens with directed movement. Cerebellar damage can also produce a type of tremor called *rubral* or *Holmes' tremor*—a combination of rest, action, and postural tremors. The tremor is often most prominent when the affected person is active or is maintaining a particular posture. Cerebellar tremor may be accompanied by *dysarthria* (speech problems), *nystagmus* (rapid, involuntary movements of the eyes), gait problems, and postural tremor of the trunk and neck.

Psychogenic tremor (also called functional tremor) can appear as any form of tremor movement. The characteristics of this kind of tremor may vary but generally include sudden onset and remission, increased incidence with stress, change in tremor direction and/or body part affected, and greatly decreased or disappearing tremor activity when being distracted. Many individuals with psychogenic tremor have a conversion disorder (defined as a psychological disorder that produces physical symptoms) or another psychiatric disease.

Orthostatic tremor is characterized by rhythmic muscle contractions that occur in the legs and trunk immediately after standing. The person typically perceives orthostatic tremor as unsteadiness rather than actual tremor. Because of its high tremor frequency, often the tremor cannot be seen, but sometimes be heard when putting a stethoscope to the thigh muscles. No other clinical signs or symptoms are present and the unsteadiness ceases when the individual sits, is lifted off the ground, or starts walking.

Physiologic tremor, the most common form of tremor, occurs in every normal individual. It is rarely visible to the eye and typically involves a fine shaking of the hands. Physiological tremor is not considered a disease and is not caused by the brain, but is due to mechanical properties of the body combined with body rhythms such as heart beat and muscle contractions. It may be heightened by strong emotion (such as anxiety or fear), physical exhaustion,

hypoglycemia, hyperthyroidism, heavy metal poisoning, stimulants, alcohol withdrawal, caffeine, or fever. It can occur in all voluntary muscle groups and can be detected by extending the arms and placing a piece of paper on top of the hands. *Enhanced physiologic tremor* is a strengthening of physiologic tremor to more visible levels. It is generally not caused by a neurological disease but 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.

Tremor can result from other conditions as well. Alcoholism, excessive alcohol consumption, or alcohol withdrawal can kill certain nerve cells, resulting in tremor, especially in the hand. (Conversely, small amounts of alcohol may even help to decrease essential tremor, but the mechanism behind this is unknown. Doctors may use small amounts of alcohol to aid in the diagnosis of certain forms of tremor but not as a regular treatment for the condition.) Tremor in *peripheral neuropathy* may occur when the nerves that supply the body's muscles are traumatized by injury, disease, abnormality in the central nervous system, or as the result of systemic illnesses. Peripheral neuropathy can affect the whole body or certain areas, such as the hands, and may be progressive. Resulting sensory loss may be seen as a tremor or *ataxia* (inability to coordinate voluntary muscle movement) of the affected limbs and problems with gait and balance. Clinical characteristics may be similar to those seen in people with essential tremor.

How is tremor diagnosed?

During a physical exam a doctor can determine whether the tremor occurs primarily during action or at rest. The doctor will also check for tremor symmetry, any sensory loss, weakness or muscle atrophy, or decreased reflexes. A detailed family history may indicate if the tremor is inherited. Blood or urine tests can detect thyroid malfunction, other metabolic causes, and abnormal levels of certain medications that can cause tremor. These tests may also help to identify contributing causes, such as drug interaction, chronic alcoholism, or another condition or disease. Diagnostic imaging using computerized tomography or magnetic resonance imaging may help determine if the tremor is the result of a structural defect or degeneration of the brain.

The doctor will perform a neurological exam to assess nerve function and motor and sensory skills. The tests are designed to determine any functional limitations, such as difficulty with handwriting or the ability to hold a utensil or cup. The person may be asked to place a finger on the tip of her or his nose, draw a spiral, or perform other tasks or exercises.

The doctor may order an electromyogram to diagnose muscle or nerve problems. This test measures involuntary muscle activity and muscle response to nerve stimulation.

Are there any treatments?

There is no cure for most tremors.

The appropriate treatment depends on accurate diagnosis of the cause.

Some tremors respond to treatment of the underlying condition. For example, in some cases of psychogenic tremor, treating the individual's underlying psychological problem may cause the tremor to disappear.

Symptomatic *drug therapy* is available for several forms of tremor. Drug treatment for parkinsonian tremor involves levodopa and/or dopamine-like drugs such as pramipexole and ropinirole. Other drugs used to lessen parkinsonian tremor include amantadine hydrochloride and anticholinergic drugs.

Essential tremor may be treated with propranolol or other beta blockers (such as nadolol) and anticonvulsant drugs such as primidone.

Cerebellar tremor typically does not respond well to medical treatment. Dystonic tremor may respond to clonazepam, anticholinergic drugs, and intramuscular injections of botulinum toxin. Botulinum toxin is also prescribed to treat voice and head tremors and several movement disorders.

Clonazepam and primidone may be prescribed for primary orthostatic tremor.

Enhanced physiologic tremor is usually reversible once the cause is corrected. If symptomatic treatment is needed, beta blockers can be used.

Eliminating tremor “triggers” such as caffeine and other stimulants from the diet is often recommended

Physical therapy may help to reduce tremor and improve coordination and muscle control for some patients. A physical therapist will evaluate the individual for tremor positioning, muscle control, muscle strength, and functional skills. Teaching the person to brace the affected limb during the tremor or to hold an affected arm close to the body is sometimes useful in gaining motion control. Coordination and balancing exercises may help some individuals. Some therapists recommend the use of weights, splints, other adaptive equipment, and special plates and utensils for eating.

Surgical intervention such deep brain stimulation or thalamotomy may ease certain tremors. These surgeries are usually performed only when the tremor is severe, cannot be controlled satisfactorily with drugs, and will have a significant impact on the daily life of an individual with tremor.

Deep brain stimulation (DBS), the most common form of surgical treatment of tremor, uses implantable electrodes to send high-frequency electrical signals to the thalamus. The person uses a hand-held magnet to turn on and turn off a pulse generator that is surgically implanted under the skin. The electrical stimulation temporarily disables the tremor and can be “reversed,” if necessary, by turning off the implanted electrode. Batteries in

the generator last about 5 years and can be replaced surgically. DBS is currently used to treat parkinsonian tremor, essential tremor, and dystonia.

Thalamotomy, involving the creation of lesions in the brain region called the thalamus, is quite effective in treating patients with essential, cerebellar, or parkinsonian tremor. This in-hospital procedure is performed under local anesthesia, with the individual awake. After the patient's head is secured in a metal frame, the surgeon maps the person's brain to locate the thalamus. A small hole is drilled through the skull and a temperature-controlled electrode is inserted into the thalamus. A low-frequency current is passed through the electrode to activate the tremor and to confirm proper placement. Once the site has been confirmed, the electrode is heated to create a temporary lesion. Testing is done to examine speech, language, coordination, and tremor activation, if any. If no problems occur, the probe is again heated to create a 3-mm permanent lesion. The probe, when cooled to body temperature, is withdrawn and the skull hole is covered. The lesion causes the tremor to permanently disappear without disrupting sensory or motor control.

The most common side effects of tremor surgery include dysarthria (problems with motor control of speech), temporary or permanent cognitive impairment (including visual and learning difficulties), and problems with balance.

What research is being done?

The National Institute of Neurological Disorders and Stroke, a unit of the National Institutes of Health (NIH) within the U.S. Department of Health and Human Services, is the nation's leading federal funder of research on disorders of the brain and nervous system. The NINDS sponsors research on tremor both at its facilities at the NIH and through grants to medical centers across the country.

Scientists at the NINDS are evaluating the effectiveness of 1-octanol and octanoic acid, substances closely related to alcohol but not intoxicating, for treating essential tremor. Results of previous NIH studies have shown these agent to be promising as potential new treatments. Furthermore, an ongoing study is trying to find out how alcohol is capable of reducing tremor in essential tremor.

Other researchers are trying to determine if transcranial Direct Current Stimulation, which uses small electrodes placed on the scalp to deliver continuous low electrical current to areas of the brain involved with movement, can improve essential tremor.

NINDS further conducts research to search for genes that can cause essential tremor.

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
www.ninds.nih.gov

Information also is available from the following organizations:

International Essential Tremor Foundation

P.O. Box 14005
Lenexa, KS 66285-4005
913-341-3880
888-387-3667
www.essentialtremor.org

Tremor Action Network

P.O. Box 5013
Pleasanton, CA 94566-5013
510-681-6565
925-462-0111
www.tremoraction.org

National Ataxia Foundation

2600 Fernbrook Lane North
Suite 119
Minneapolis, MN 55447-4752
763-553-0020
www.ataxia.org

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