

Overview of the Peripheral Nervous System and Reflex Mechanisms

Peripheral Nervous System

PNS main subdivisions

Somatic subdivision

Autonomic (ANS) subdivision

Sympathetic aspect

Parasympathetic aspect

Enteric nervous system

Outside of the brain and spinal cord

Motor nerves

Sensory nerves

Ganglia

12 pairs of cranial nerves

31 pairs of spinal nerves

Autonomic nervous system = peripheral nerves that regulate automatic body functions

The PNS is responsible for transmitting messages from the sense organs (nose, ears, eyes) and sensory receptors in the soft tissue to the CNS and then relaying messages from the CNS back to the organs, glands, skeletal muscles, and joints to maintain homeostasis and perform functions to maintain life.

Practical Application

Stimulation of the peripheral nervous system and the responses elicited by this stimulation constitute one of the main physiologic ways massage and bodywork benefit the client. Therefore it is important to thoroughly understand the anatomy and physiology of the peripheral nervous system and the way soft tissue and movement methods interact with the peripheral nervous system.



Nerves

Sensory nerves

Transmit input from sensory receptors

Motor nerves

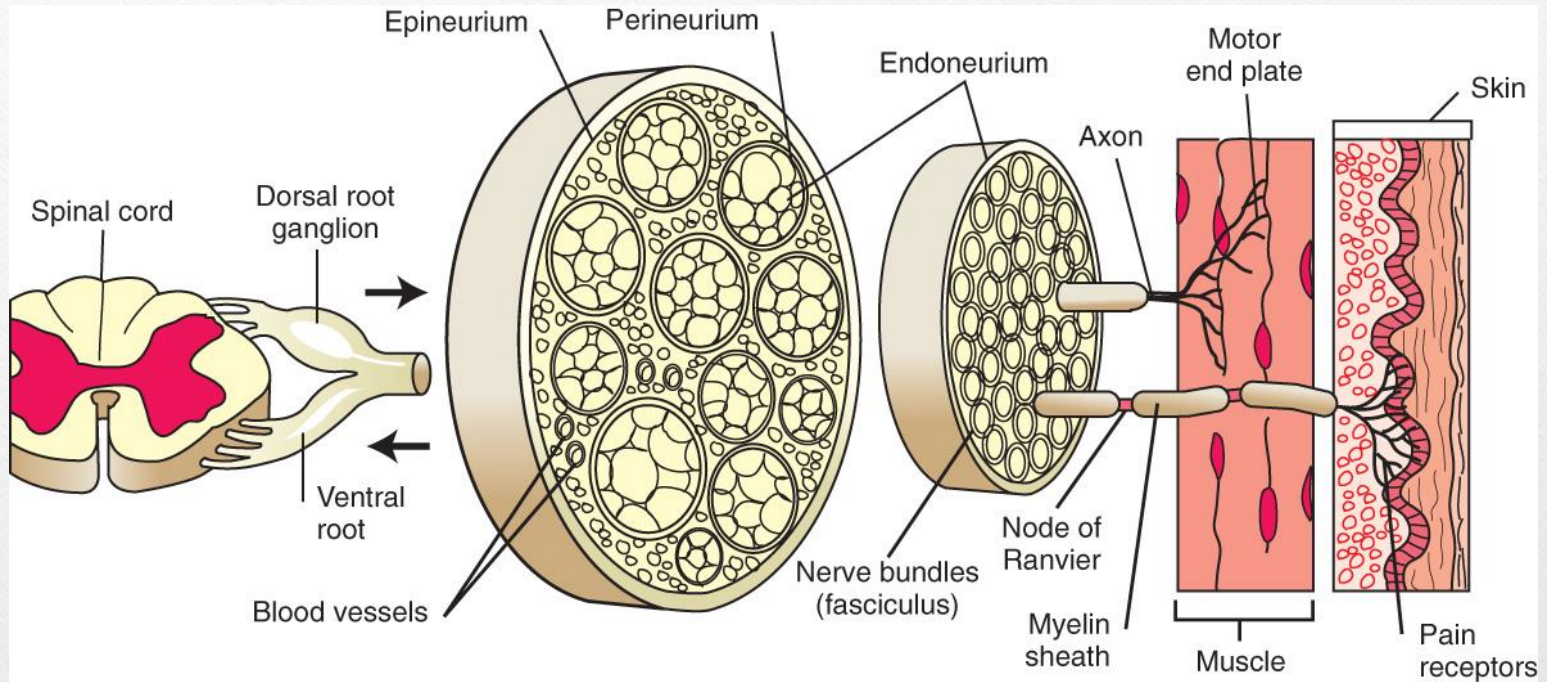
Innervate or provide action

Mixed nerves

Contain sensory and motor fibers

Afferent nerves carry information to the central nervous system, whereas efferent nerves carry impulses back to the body.

Connective Tissues of the Nerves



A delicate connective tissue covering known as the endoneurium surrounds and holds each nerve fiber.

A group of nerve fibers is called a fasciculus, and each fascicle is surrounded by a sheath of connective tissue called the perineurium.

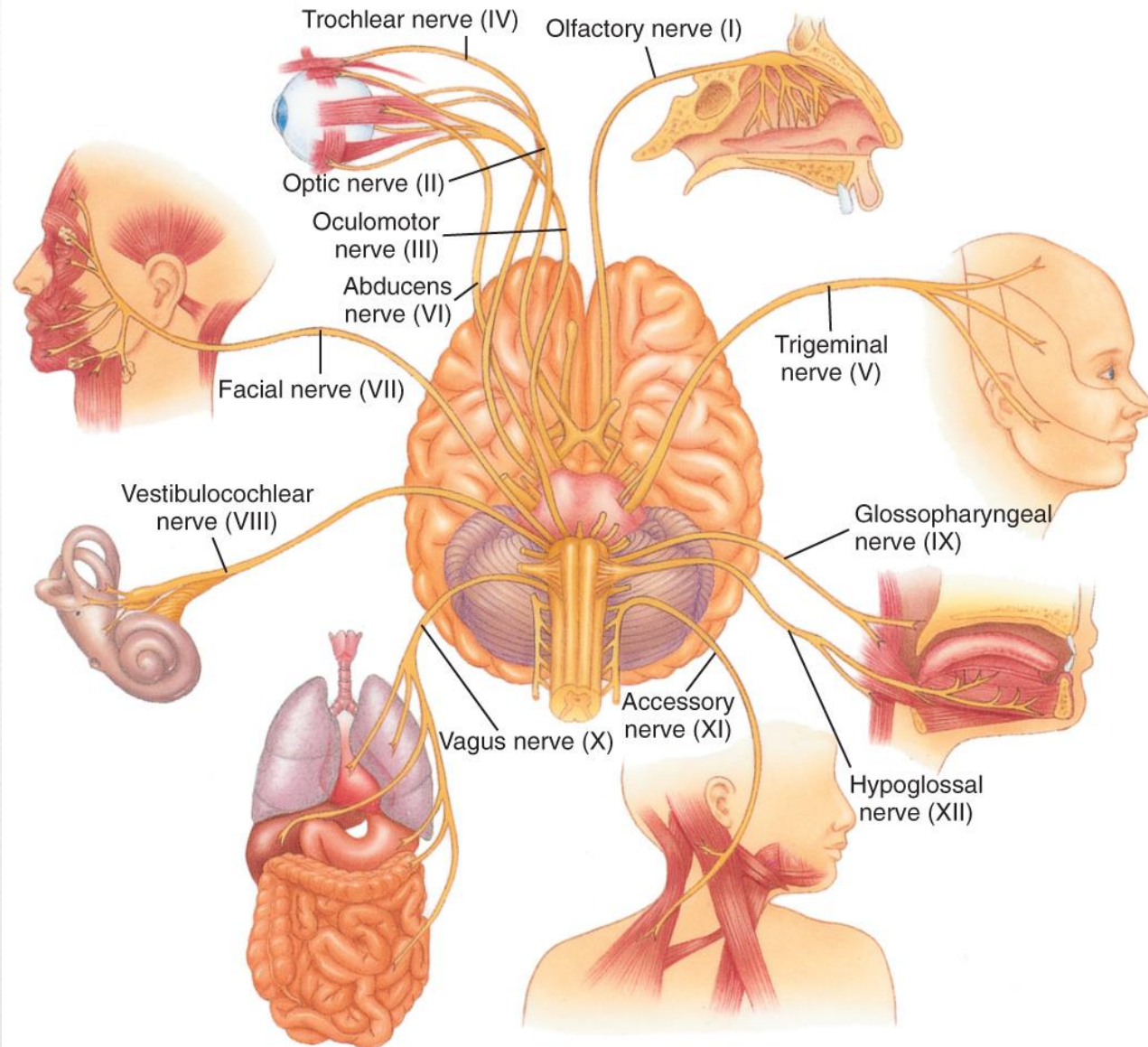
The entire nerve is surrounded by a connective tissue covering called the epineurium.

Cranial Nerves

Cranial nerves

Twelve pairs enter (sensor) or leave (motor) the olfactory bulbs, thalamus, visual cortex, and brainstem

Cranial nerves are identified by Roman numerals (order from front to back of brain) and names (refer to function or distribution).



Disorders of cranial nerves can arise from a stroke or tumor or from trauma.

A lack of function may indicate damage to a nerve associated with a certain function. For example, Bell's palsy (paralysis of facial muscles) may be caused by injury to or inflammation of the seventh cranial nerve.

Cranial Nerves: Vagus Nerve

Practical Application

The distribution of the vagus nerve affects many visceral functions. Massage has been shown to support vagus nerve function, especially in premature babies, resulting in better development (particularly in weight gain) and fewer developmental problems.

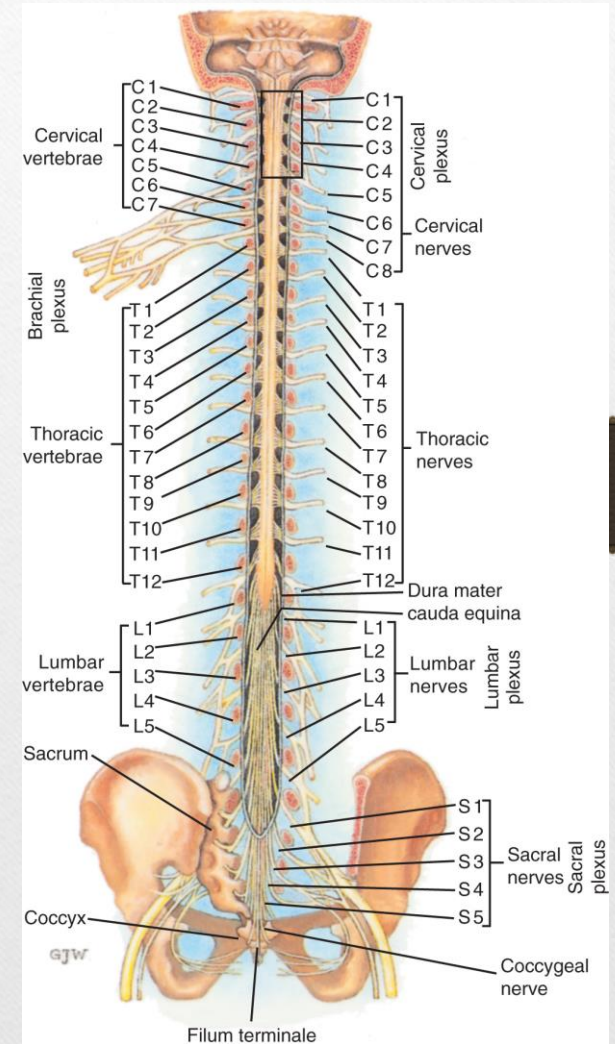


Spinal Nerves

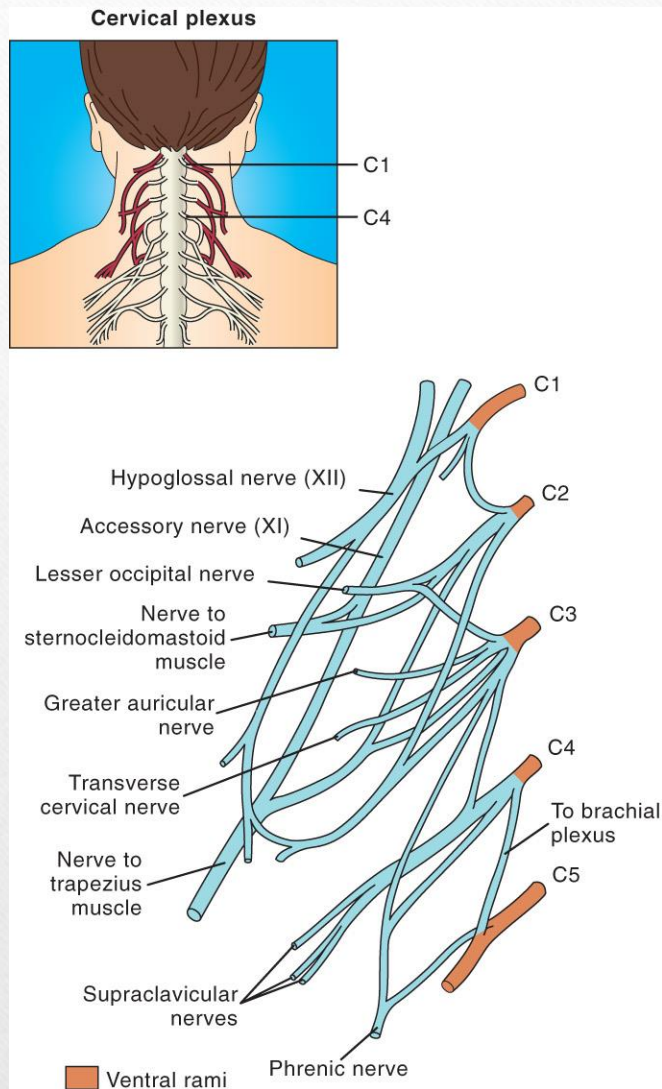
Spinal nerves

Thirty-one pairs originate in the spinal cord and emerge from the vertebral column.

Spinal nerves are identified by a letter and number, which refer to their segment of attachment to the spinal cord.



Cervical Plexus



Nerve	Innervation
Ansa cervicalis	Hyoid muscles
Lesser occipital	Skin behind and above the ear
Greater auricular	Skin in front of, below, and over the ear and parotid glands
Transverse cervical	Skin on the anterior portion of the neck
Phrenic	Diaphragm
Supraclavicular	Skin on the shoulders and upper portion of the chest
Segmental branches	Deep neck muscles, midscalenes, and levator scapula muscle

Most of the spinal nerves converge in small groups to form an intersecting network; this network of nerves is a plexus.

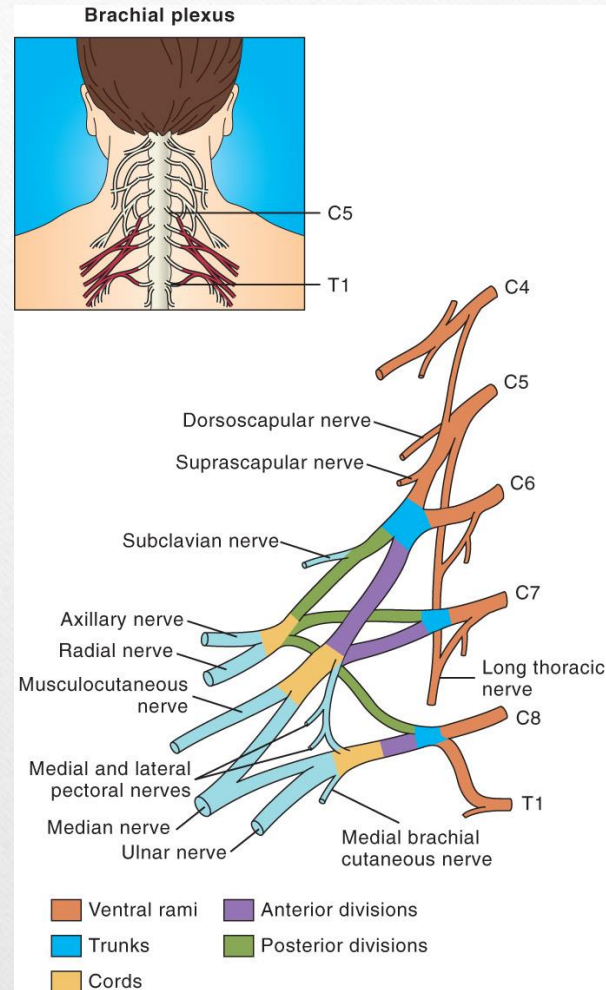
The cervical plexus is made up of nerves C1 through C4 and part of C5.

Injury can cause loss of sensation and/or flaccid paralysis of the head, neck, and shoulders.

Nerve plexuses can be considered endangerment sites for deep sustained pressure during massage.

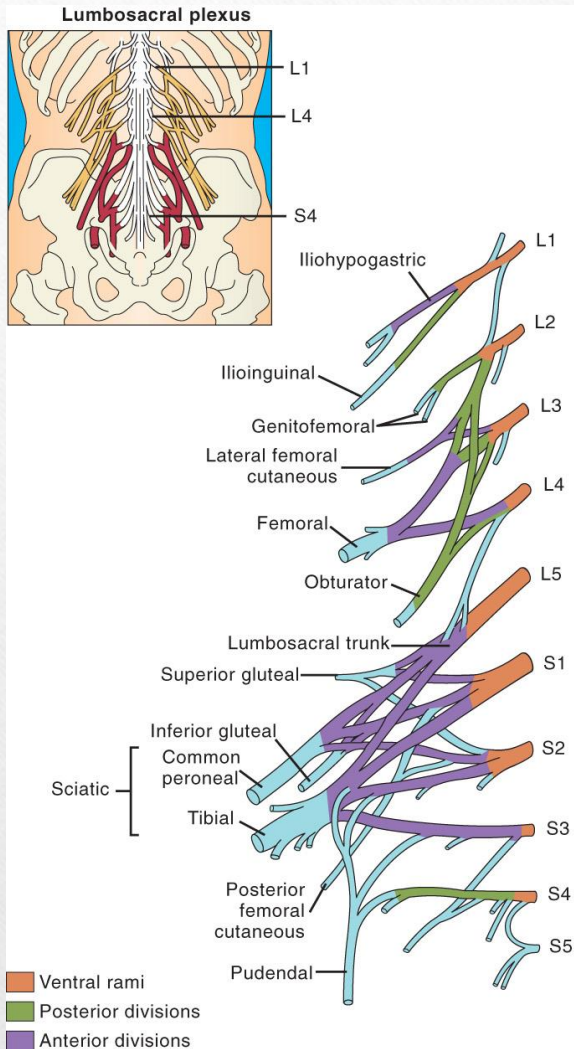
Brachial Plexus

The brachial plexus is made up of nerves C5 through T1; it supplies the skin and muscles of the upper limbs.



Nerve	Innervation
Dorsoscapular	Superficial muscles of the scapula
Long thoracic	Serratus anterior muscle
Subclavian	Subclavius muscle
Suprascapular	Infraspinatus and supraspinatus muscles
Musculocutaneous	Biceps, brachialis, and coracobrachialis muscles; skin
Subscapular	Subscapularis and teres major muscles
Median	Forearm flexors and palmar surface of the skin of the thumb, index, and middle fingers
Thoracodorsal	Latissimus dorsi muscle
Pectorals	Pectoralis major and minor muscles
Axillary	Deltoid and teres minor muscles and skin
Radial	Triceps and forearm extensors, skin of the forearm and hand, and dorsal surface of the thumb, index, and middle fingers
Medial cutaneous	Skin of the arm
Ulnar	Muscles of the hand and skin of the ring and pinkie fingers

Lumbosacral Plexus



Nerve	Innervation
Iliohypogastric	Abdominal muscles and skin of the abdomen and buttocks
Ilioinguinal	Abdominal muscles and skin of the external genitalia
Genitofemoral	Skin of the external genitalia and inguinal region
Lateral femoral	Skin of the thigh (except the medial cutaneous portion)
Femoral	Hip flexors and extensors and skin of the medial and anterior thigh and medial leg and foot
Obturator	Adductor muscles and skin of the medial thigh
Sacral plexus	Created from nerves L5 to S3
Sciatic	Leg and foot muscles; the skin of the foot, which divides into the tibial and peroneal nerves at the popliteal fossa
Gluteal	Buttocks and tensor fasciae latae muscle
Nerves to hip	Piriformis, quadratus femoris, rotators, obturator internus, and superior and inferior gemellus
Posterior femoral	Skin of the buttocks, perineum, back, cutaneous of the thigh, and leg
Pudendal	Muscles and skin of the perineum (may be considered in the coccygeal plexus)

The lumbosacral plexus is made up of the lumbar plexus and the sacral plexus.

The sciatic nerve supplies the lower body.

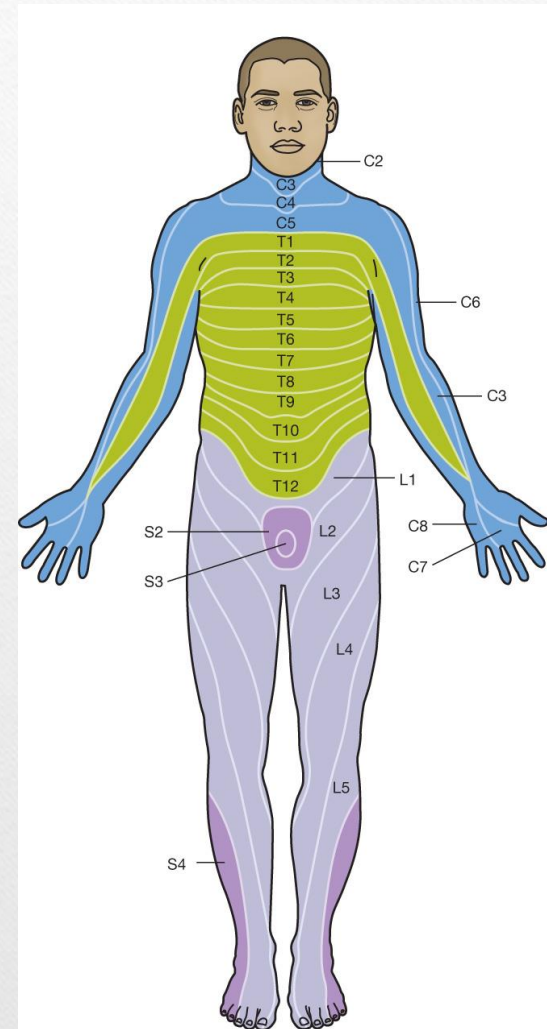
Injury to this plexus can cause loss of sensation and/ or flaccid paralysis of the abdomen and lower extremities.

Dermatomes

Sections of skin supplied by a single nerve

Match up with pathways of Chinese meridians

Although this diagram doesn't show it, many of the nerve supplies to adjacent dermatomes overlap.



Myotomes indicate the relationship between the spinal nerve and the muscles innervated by it.

A skeletal muscle or group of muscles that receives motor axons from a single spinal nerve is known as a myotome.

As with dermatomes, the boundaries of myotomes are not always exact.

Reflex Mechanisms

Nerve reflex: involuntary action

Two types:

- Simple or unconditioned or natural

 - No thinking or reasoning

- Complex or conditioned

 - Conditioned response

 - Fast response time

 - Allow body to prevent injury

In the simple, unconditioned, or natural type of reflex, the brain is not directly involved. The processing occurs in the spinal cord. An example of a simple reflex is blinking the eyes in the presence of a strong light.

The complex, or conditioned, reflex involves the brain, but it is also as fast as the simple reflex. Salivation while smelling a favorite food is an example of a conditioned reflex.

Reflex Patterns

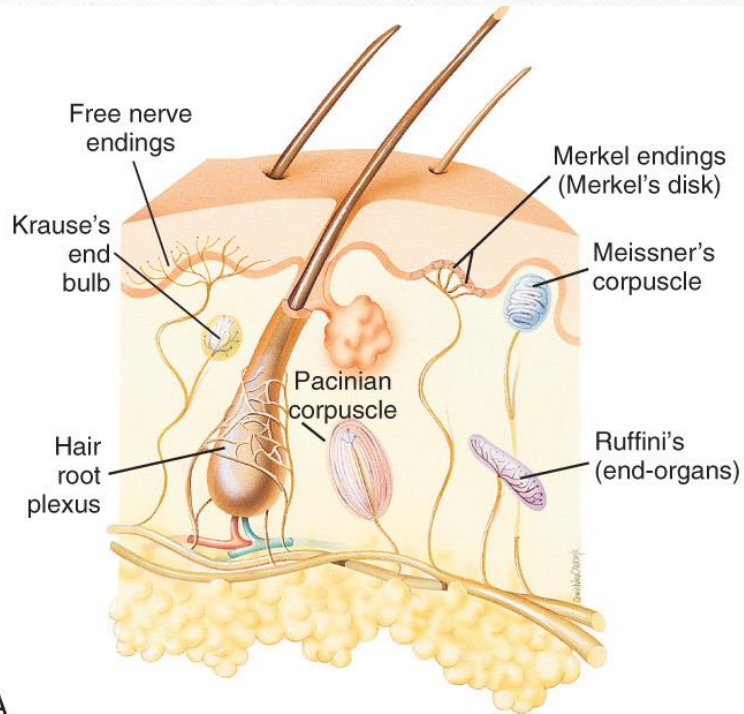
Somatosomatic: *stimulus on the skin, tendons, or joints that produces a reflex on a related somatic structure*

Somatovisceral: *somatic stimulation results in reflex in a visceral structure.*

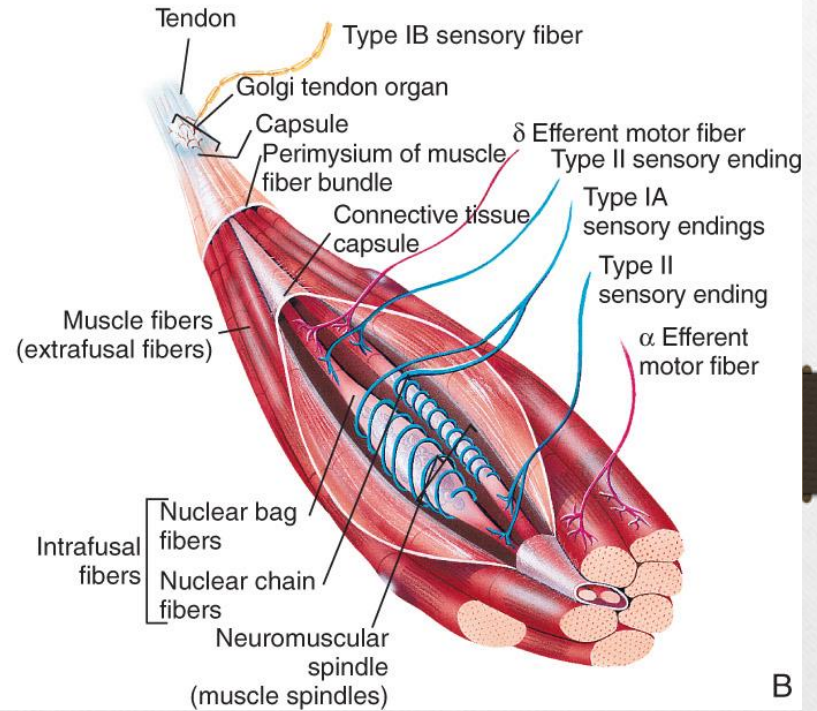
Viscerosomatic: *localized visceral stimulus produces a somatic response.*

Viscerovisceral: *visceral stimulus produces visceral response.*

Sensory Receptors



A



B

Exteroceptors are on or near the body's surface and are sometimes called cutaneous receptors. Visceroceptors (interoceptors) are located internally, often within body organs, or viscera. Proprioceptors are a specialized type of visceroreceptor in muscles, joints, and tendons.

Thermal receptors (free nerve endings) specifically detect temperature, whereas mechanical receptors can identify touch and pressure, among other things. Thermal receptors are a subcategory of mechanical receptors.

Reflex Arc

Stretch reflex

Tendon reflex

Flexor reflex

Crossed extensor reflex

Proprioception

Gamma motor neuron discharge

Fascial innervations

Stretch reflex: protective contraction when a muscle is stretched suddenly or intensely.

The tendon reflex is also known as the inverse stretch reflex.

The flexor reflex causes all the right muscles in an endangered limb to contract in order to withdraw the limb.

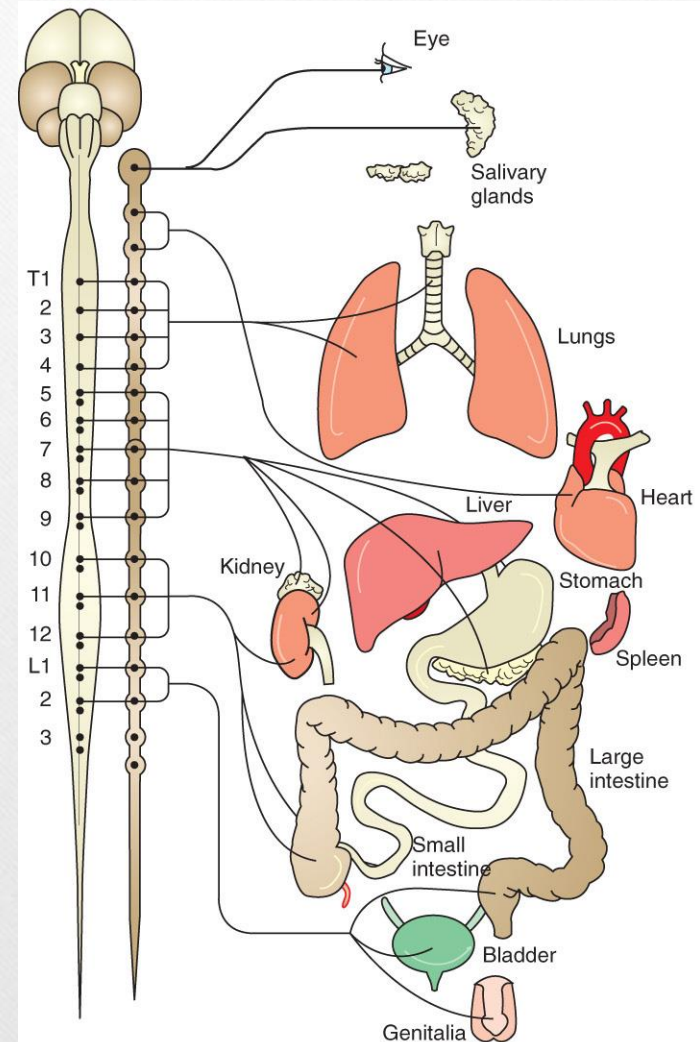
These mechanisms play a role in how the body processes mechanical forces imposed on the body during massage, as well as various muscle energy methods and stretches.

The Autonomic Nervous System, the Five Senses, and Pathologic Conditions of the Peripheral Nervous System

Sympathetic Nervous System

The sympathetic nervous system stimulates.

It usually functions when the body is under stress.

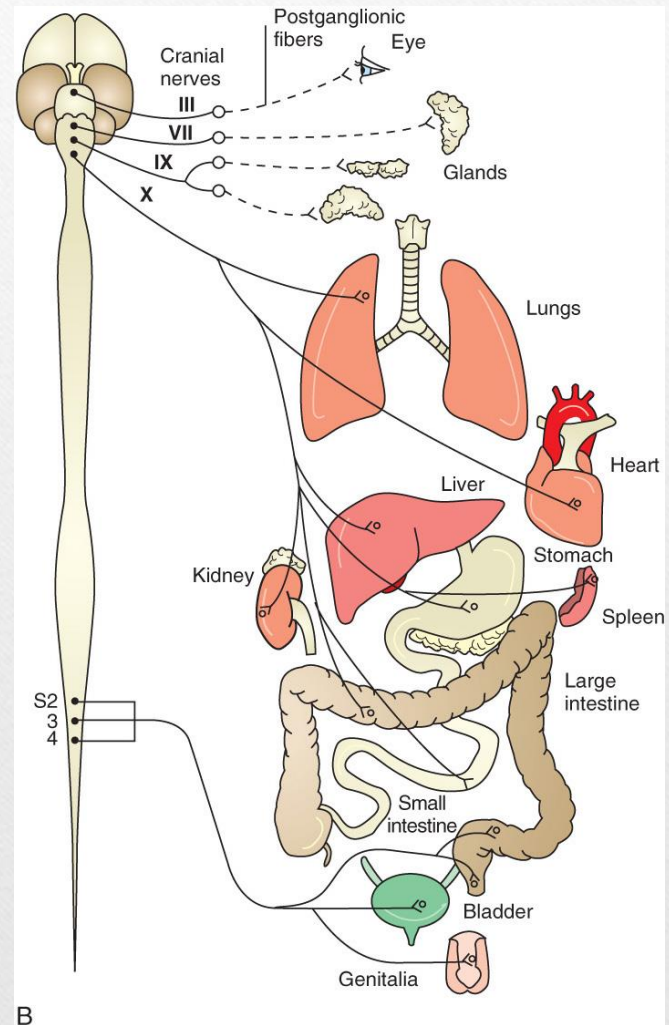


Parasympathetic Nervous System

The parasympathetic nervous system tends to diminish or inhibit actions.

It works under normal body conditions to conserve energy.

Massage modalities initially stimulate sympathetic functions. Homeostatic mechanisms then work to increase restorative parasympathetic functions as needed.



Structure and Function

Sympathetic

- Begins in spinal cord

- Major function: emergency response

- Responds whether threat is real or imagined

Parasympathetic

- Cranial nerves to organs

- Energy conservation system

- Regulates digestion, slows heart rate

Reactions to parasympathetic stimulation are highly localized and tend to counteract some of the effects of the sympathetic nervous system.

Massage therapists elicit a parasympathetic response by Point holding methods, such as acupressure, reflexology, and acupuncture, cause a release of endorphins that stimulate the parasympathetic responses of relaxation and contentment.

Eastern/Western Connection

ANS is an example of yin/yang concept.

Correlation between sympathetic ANS function and organ points in Asian meridian system

Overlap between acupuncture points and meridians to fascial planes of body

The effects of many neurotransmitters may validate the use of sensory stimulation methods, such as acupressure, reflexology, and acupuncture, to treat pain and anxiety.

Five Basic Senses

Touch

Hearing

Vision

Taste

Smell

More than 20 senses have been identified; these five are the most basic.

Touch

The areas of the body that have more nerve endings are more sensitive.

Tongue, lips, thumb, and fingers have the most touch sensitivity.

Four touch sensations

Cold

Heat

Contact

Pain

The sense of touch occurs in the body as nerve endings in the skin called sensory receptors transmit sensations to the brain.

Hearing

Sounds are vibrations turned into recognizable patterns.

Hearing is well-developed—even at birth!

Vibrations taken in by external ear

Funneled into middle ear, eardrum

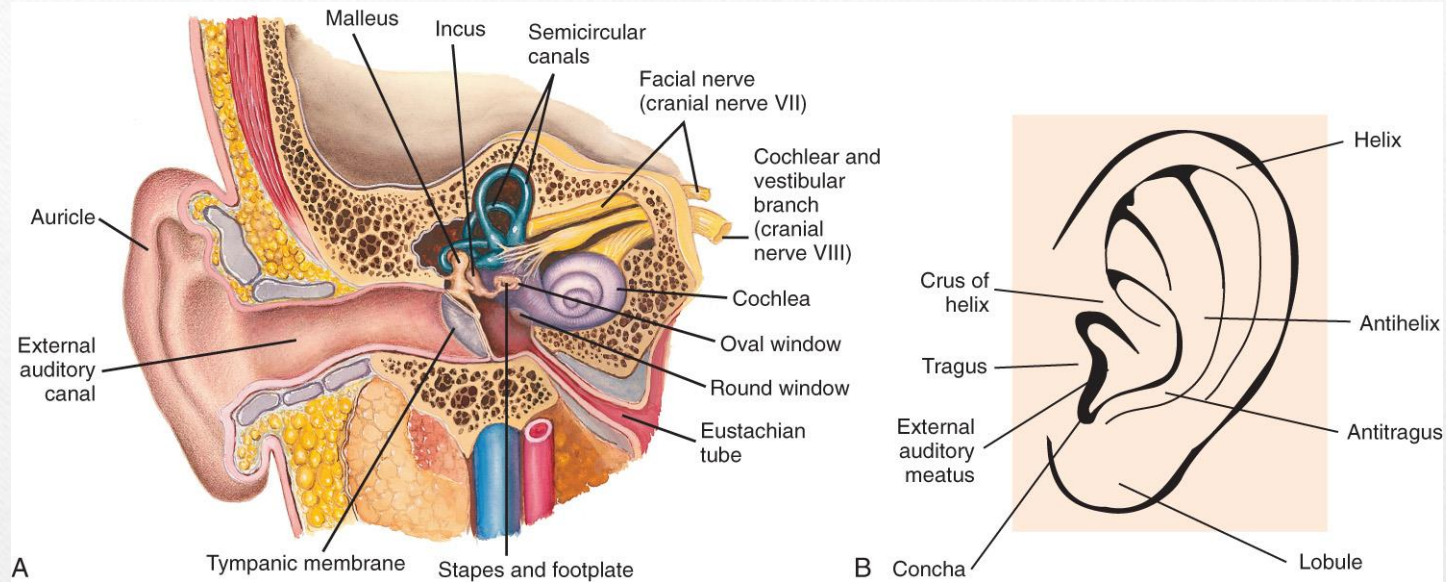
Eardrum vibrates, pulls tiny bones

Sensory information transformed into electrical signals,
then conducted to the brain

If our sense of hearing is well-developed at birth, how about in the womb? Does a fetus respond to sound? (Recent research has shown this to be the case. Sound carries reasonably well through amniotic fluid.)

The stirrup bone inside the ear is the smallest bone in the body.

Structures of the Ear

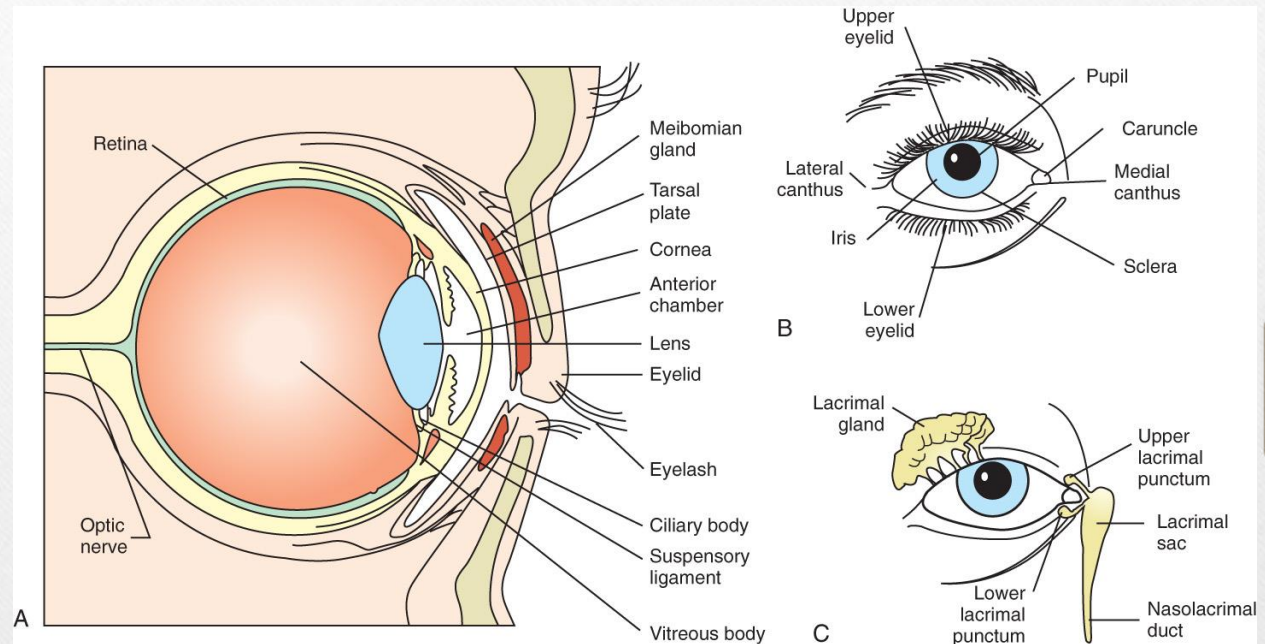


The vestibular system helps us maintain our balance.

Only the inner ear functions in the vestibular system.

Vision

The cerebral cortex interestingly, signals from the right and left eye stay separate until the brain sorts them out.



Iridology is the science that specializes in relations between disease and the shape, color, and other individual characteristics of the iris.

Taste

One of the more complex senses

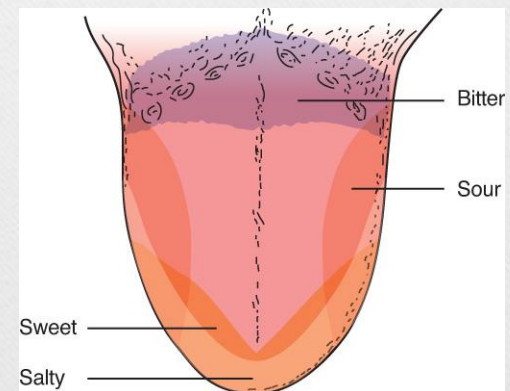
Connected to smell

Average adult has more than ten thousand taste buds.

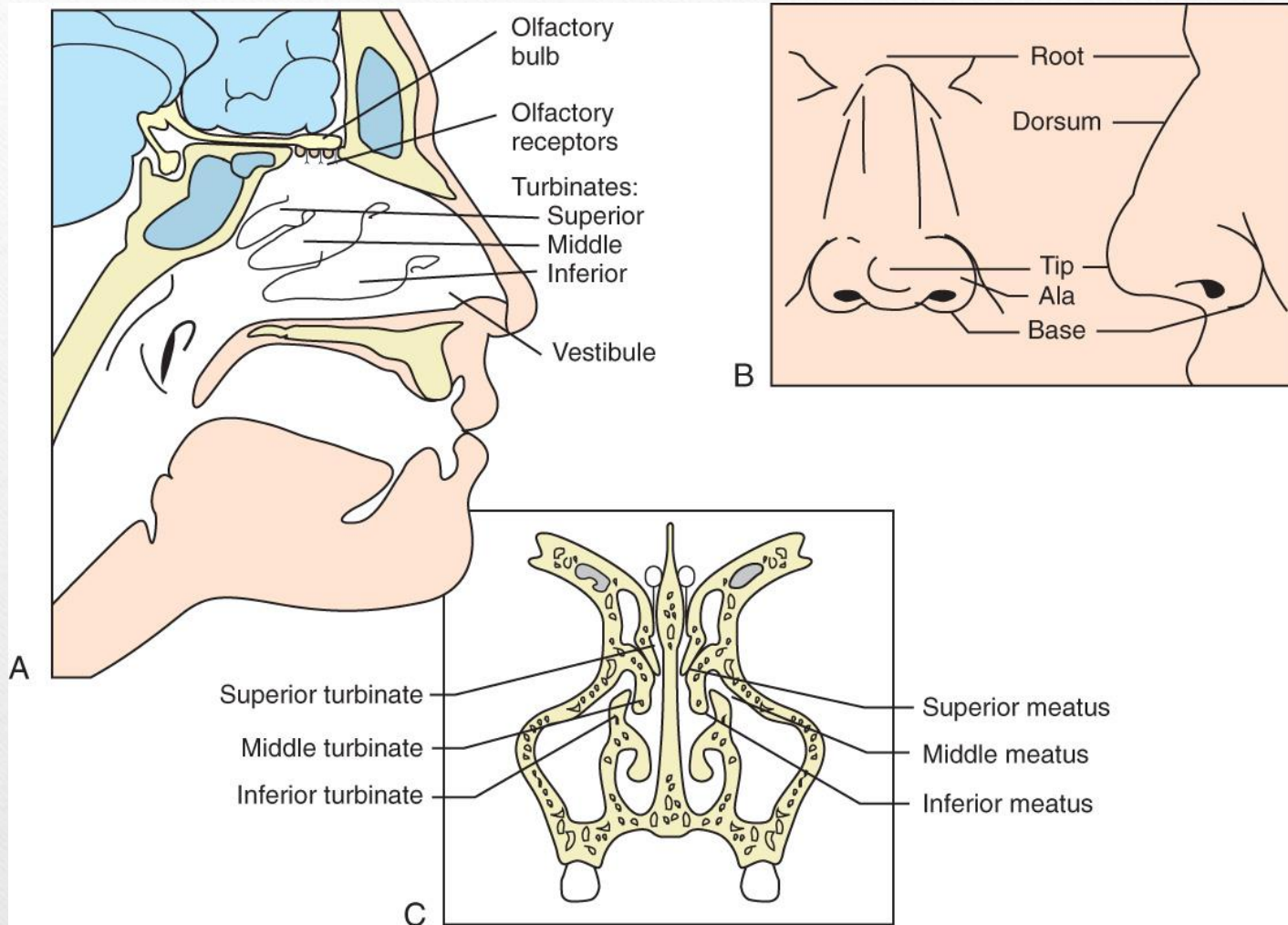
Culture and genetics determine preferences for certain kinds of food.

The four taste areas on the tongue are sweet, salty, sour, and bitter. All other taste sensations come from smell.

TCM doctors use the tongue for diagnosis.



Smell



When an odor makes contact with the chemical receptors in the roof of the nasal cavity, those receptors transform the odor into chemical signals to be transported to the brain.

TCM doctors will “smell” a patient’s body odors and breath for diagnosis—a lot of information can be determined with this sense.

Medications and the Autonomic Nervous System

Alpha-adrenergic blockers

Beta-adrenergic medications

Beta-adrenergic blockers

Parasympathetic blockers

Adrenergic is an adjective that describes anything activated by epinephrine or an epinephrine-like substance.

Pathologic Conditions

Compression syndromes

Nerve root compression

Disk herniation

Massage considerations:

If combined with other methods, surgery may not be necessary.

If surgery performed, obtain physician clearance.

Work close to surgical area can begin after stitches have been removed and all inflammation abates.

8-12 weeks before direct work on a new scar

Compression syndromes, entrapment neuropathies, and nerve impingement (pinched nerve) are disorders of the peripheral nerves characterized by pain or loss of function (motor, sensory, or both) of the nerves as a result of chronic compression. ‘Pinched’ nerves are most common.

Carpal tunnel syndrome is the compression of the median nerve as it passes under the transverse carpal ligament at the palmar aspect of the wrist. It can be caused by anything that results in swelling of the hand or wrist, such as repetitive motion injury or fluid, especially in postmenopausal women.

Pathologic Conditions

Viral infections

Bell's palsy

Guillain-Barré syndrome

Herpes

Polio

Massage considerations:

Can be supportive and reduce stress

Follow Standard Precautions

Must gauge intensity and duration closely

Beneficial for postacute polio syndrome

The less-is-more philosophy of intervention, which calls for shorter, more frequent interventions, often is indicated.

Massage is beneficial for postacute polio syndrome but only under a doctor's supervision.

Multiple or unknown causes

Multiple sclerosis

Myasthenia gravis

Massage considerations:

Effective part of a comprehensive, long-term care program

Must gauge intensity and duration closely

Massage and other forms of bodywork can help manage secondary muscle tension caused by the alteration of posture and the use of equipment, such as wheelchairs, braces, and crutches.

Neurotransmitter-based disorders

Depression and anxiety states

Massage and exercise can play important part in treatment.

Neuropathy

Massage may provide short-term, symptomatic pain relief.

Headache

Massage indicated in chronic headache conditions

Vertigo

Massage and other forms of soft-tissue therapy are effective in treating muscle tension headaches.

Movement therapies can help or aggravate vertigo; therefore, the practitioner must take care to design an individual therapeutic program based on the client's history.

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