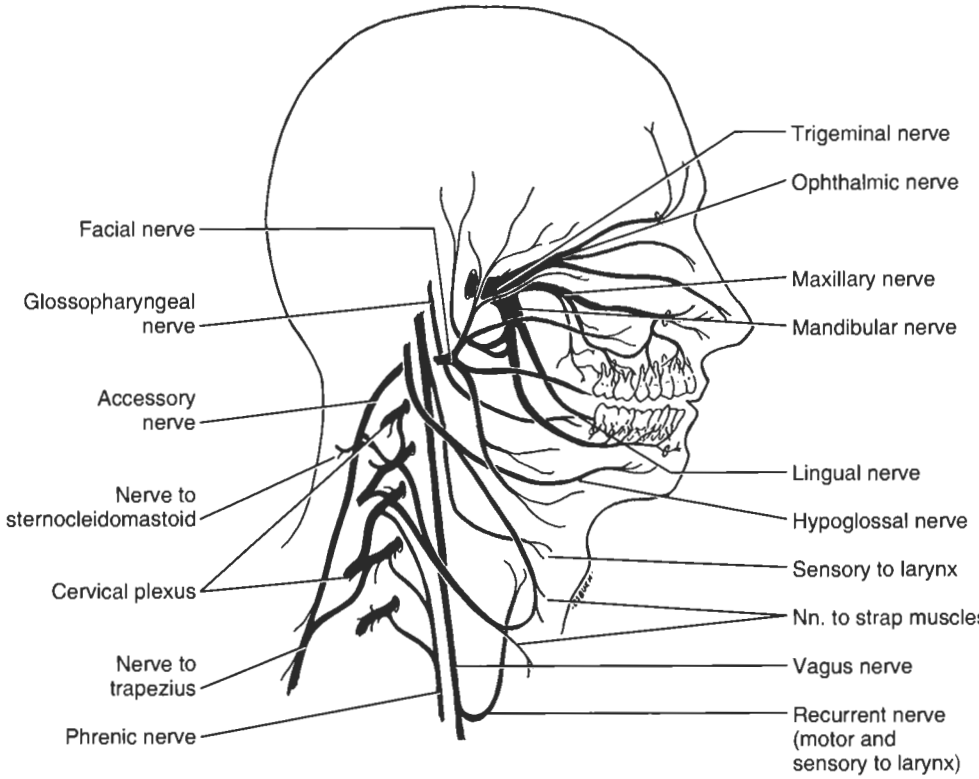

Figure 1-4 The cranial nerves accessible by acupuncture needling in the head and neck: trigeminal nerve (V, three branches: ophthalmic, maxillary, and mandibular), facial nerve (VII), and accessory nerve (XI). Also note that, activated by acupuncture stimulation, the vagus nerve plays a very important role in restoring homeostasis and antiinflammatory immune reaction (see Chapter 4 for further explanation). (From Jenkins D: *Hollinshead's functional anatomy of the limbs and back,* ed 8, Philadelphia, 2002, WB Saunders.)

The sympathetic (thoracolumbar) division (Figure 1-7) originates from neurons (*preganglionic* neurons) in the spinal cord (C8-L2).

The parasympathetic (craniosacral) division (Figure 1-8) comprises preganglionic neurons in the gray matter of the brainstem and of the middle three segments of the sacral cord (S2-4).

Sympathetic and parasympathetic nervous systems are functionally opposite to each other in the same way as the yang (active) and the yin (passive) pair in Taoist concept. The functional goal of a two-part nervous system is to balance the visceral activities.

The sympathetic system helps to maintain a constant internal body environment. To perform this function adequately, the sympathetic system is responsible for increasing adrenaline and blood sugar levels, regulating body temperature, and maintaining the contractibility of blood vessels (vasomotor tone). Such activities are needed for surviving in life-threatening situations.

This protective or survival mechanism, which results in hyperactivity of the sympathetic nervous system, is an energy-consuming process. Sometimes the sympathetic nervous system is able to inhibit pain sensation. It is well known that some soldiers do not feel pain for hours after being injured in the battlefield. In our daily lives, if hyperactivity of the sympathetic system persists too long, we become exhausted because of consuming stored energy; our immune system becomes suppressed; we are more likely to get sick; and finally our constant body environment, *homeostasis,* starts to decline. In this event the body becomes excessively sensitive to pain (hyperalgesia).

When the sympathetic nervous system calms during rest and a period of tranquility, the parasympathetic system becomes active. The decreasing

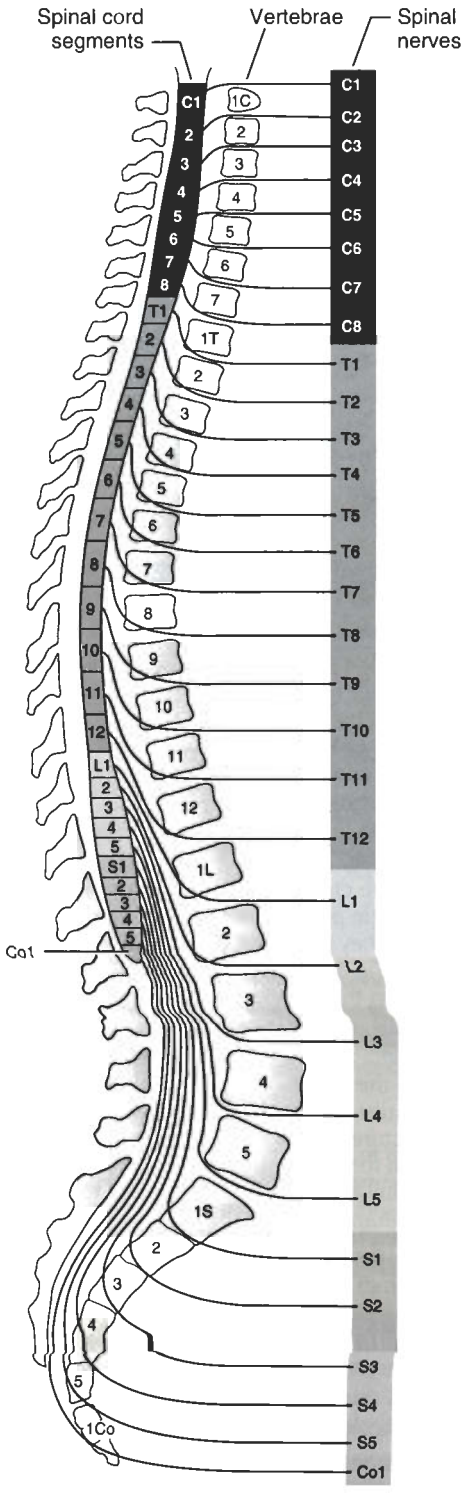

Figure 1-5 The spinal nerves that make up most of the peripheral nerves of the body. (From Jenkins D: *Hollinshead's functional anatomy of the limbs and back,* ed 8, Philadelphia, 2002, WB Saunders.)

hyperactivity of the sympathetic system ensures, for example, such functions as proper food digestion, which helps to absorb and supply energy flow to the body systems.

Clinical evidence shows that acupuncture stimulation normalizes the activities of the sympathetic and parasympathetic systems to restore optimal homeostasis, which means that acupuncture stimulation calms the sympathetic activities and activates parasympathetic functions.

Nerves and Nerve Fibers

Input signals from a peripheral nerve, carried by the dendrites of neurons, reach the cell bodies located in the ganglions, in the spinal cord, or in the brain. The processed output signals come out along the axons from the cell bodies and reach the peripheral organs, such as skin, muscles, glands, and viscera.

A nerve, also called a *nerve fiber,* may contain many dendrites and axons. The dendrites and axons existing in the same nerve fiber may convey different input or output in the form of electrical or chemical signals. A nerve or nerve fiber may carry thousands of axons and dendrites or carry just one axon or dendrite.

Different signals can travel in different directions in the same nerve. To ensure that the delivery of the functional signaling reaches the exact address, something must function like an insulating tube to cover a dendrite or axon to protect the signals. Schwann cells provide this insulating layer, called a *myelin sheath* (Figure 1-9).

As noted, all peripheral nerves are functionally categorized as either *efferent nerves* or *afferent nerves*. An efferent nerve (motor fiber) contains only axons and carries the signals from the CNS to the peripheral target organ. An afferent nerve (sensory fiber) is formed by the dendrites and carries signals to the CNS. The afferent nerve is also called a *sensory nerve.* A nerve is called a *mixed nerve* when it contains both afferent (sensory) and efferent (motor) fibers.

Efferent (Motor) Nerves Efferent nerves innervate muscles and glands and are involved in motor functions such as the contraction of muscles or the secretion of glands.

The three types of muscles are skeletal, smooth, and cardiac. In the face and head, the efferent fibers arise from the brain and innervate the muscles of mastication and the muscles of facial expression by the trigeminal nerve (V) and the facial nerve (VII), respectively. The skeletal

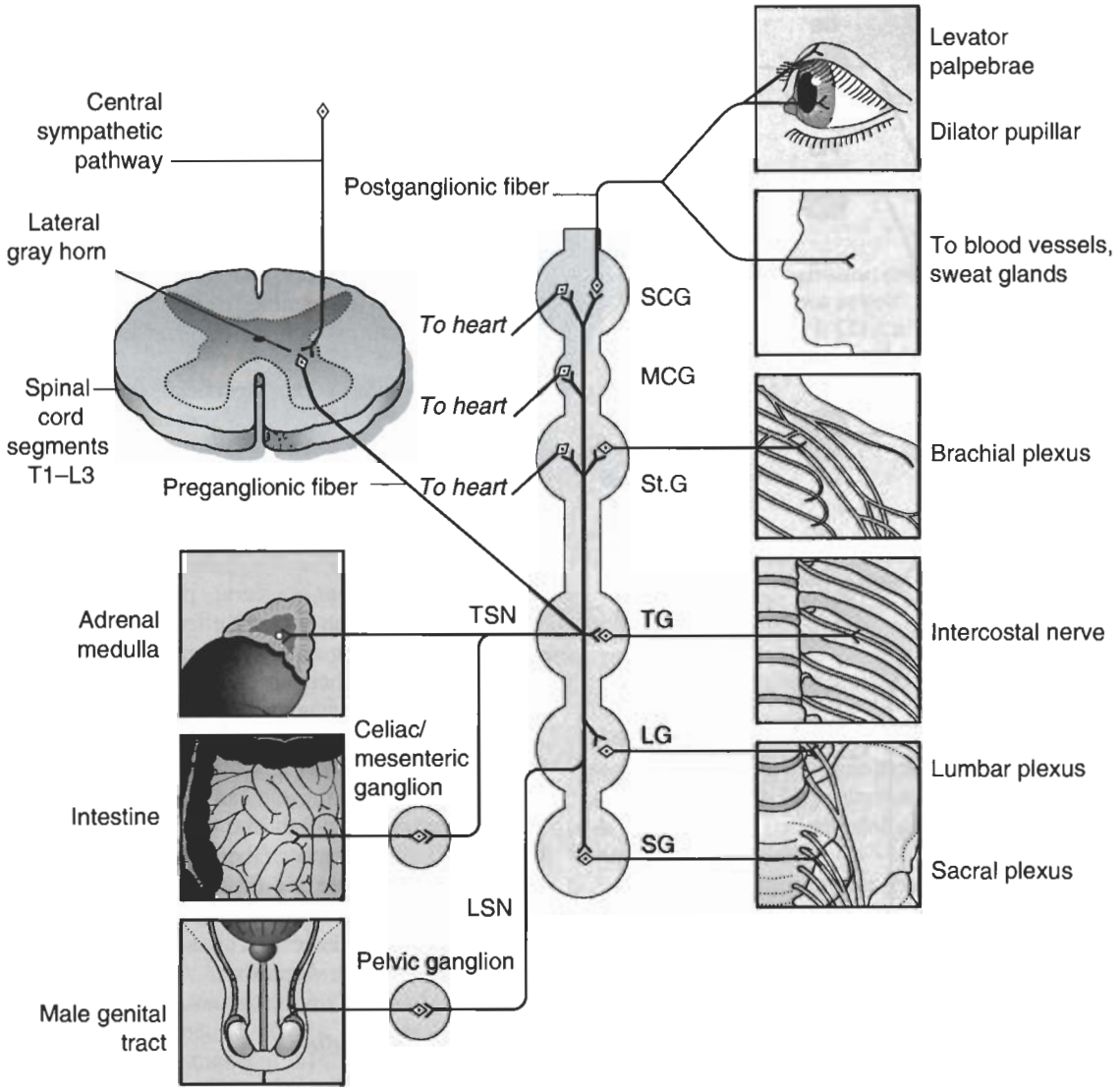

Figure 1-7 General plan of the sympathetic system. Preganglionic neurons are located in the lateral gray horn of the spinal cord. Ganglionic neurons are shown in gray. *LG,* Lumbar ganglia; *LSN,* lumbar splanchnic nerve; *MCG,* middle cervical ganglion; *SCG,* superior cervical ganglion; *SG,* sacral ganglia; *St.G,* stellate ganglion; *TG,* thoracic ganglia; *TSN,* thoracic splanchnic nerve. (From FitzGerald M, Folan-Curran J: *Clinical neuroanatomy and related neuroscience,* ed 4, Philadelphia, 2002, WB Saunders.)

Afferent Fibers and Sensory Receptors

Afferent fibers transmit the information of sensation by receptors from every part of the body to the CNS. With certain stimulation such as mechanical (piercing), chemical (acid), or physical (pressure), sensations can be generated anywhere along the afferent fibers. In acupuncture therapy this means that we may stimulate the end branch of the nerve or the middle of the nerve trunk to create input signals.

The specialized ending structure of the afferent fibers that produces sensations is called the *sensory receptor*. Different sensory receptors generate the same electrical signals, but these signals may induce different sensations in the brain, such as pain or heat.