SCALP-NEEDLING THERAPY

REVISED AND ENLARGED EDITION

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body hanging downward. Its feet at the top, its upper extremities at the middle and its head at the bottom, (see Fig. 3).

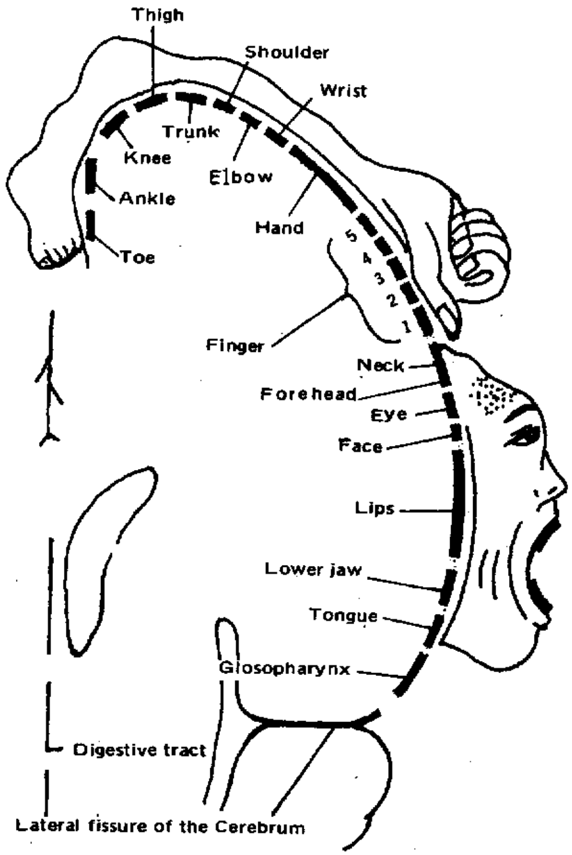

Fig.3 Frontal Section of the Left Cerebral Hemisphere through the Precentral gyrus (indicating the topographical area of motor analyzer).

When this part is injured, it gives rise to regional voluntary movement incapacity, such as unilateral paralysis, etc.

(II) The Postcentral Gyrus

As an ordinary sense of heat and pain, and a tactual analyzer, it is a high center of sensation. The functional distribution is basically similar to the precentral gyrus. When this part is injured it gives rise to paresthesia.

(III) The Middle Part of the Superior Temporal Gyrus

This is a cortical auditory analyzer. When this part is injured, it causes tinnitus, vertigo and impaired hearing.

(IV) The Supramarginal Gyrus

There is an analyzer with ability of purposeful movement to regulate the comprehensive action which are acquired by learning and practising, such as unbuttoning, drawing, carving, etc. When this part is injured, it causes incapacity of unbuttoning, ear-picking and other fine work. Clinically it is called apraxia.

(V) Broca Area

Its function is related to all muscles and flesh of the mouth, tongue, pharynx and larynx. When this area is injured, it manifests a capability of understanding spoken words, but incapability of speaking and expressing himself, i.e. motor aphasia.

(VI) The Angular Gyrus

As an visual analyzer of written letters and symbols, it is related to complicated sensation. When this area is

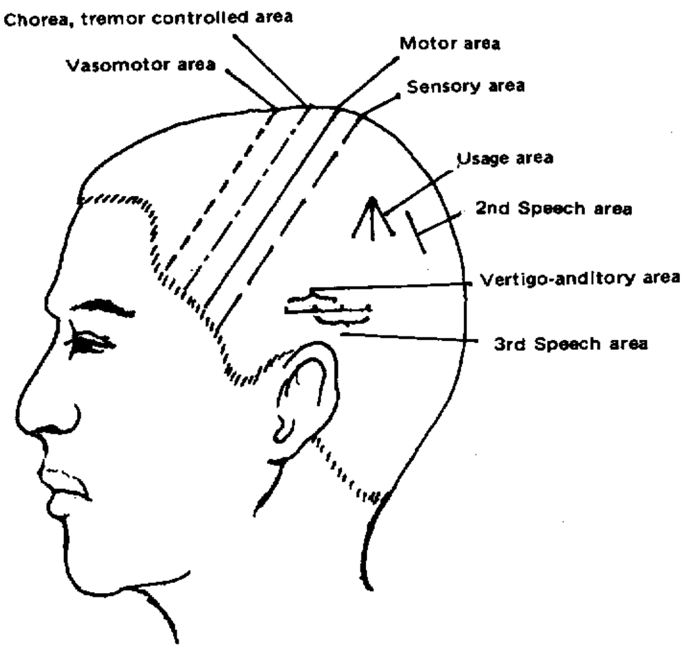

Fig.12 Lateral Surface of the Stimulation Areas

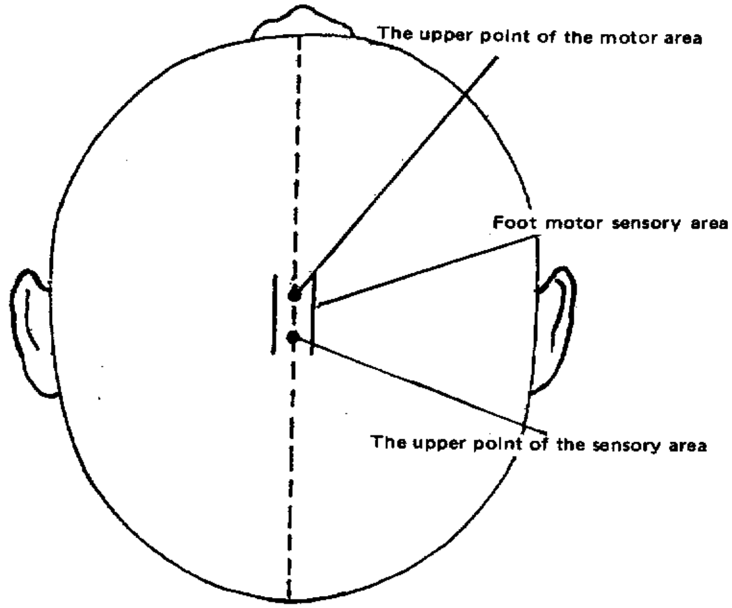

Fig.13 Parietal Surface of the Stimulation Areas

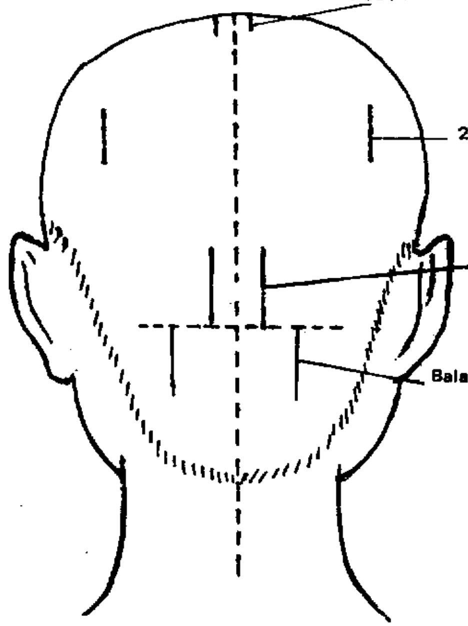

Fig.14 Posterior Surface of the Stimulation Areas

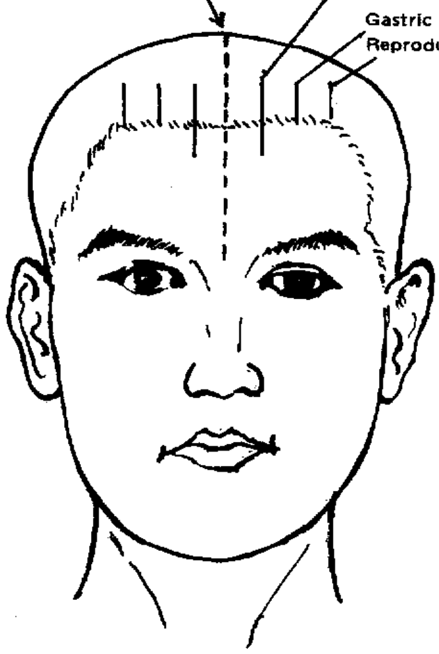

Fig. 15 Anterior Surface of the Stimulation Areas

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TEXTBOOK of MEDICAL PHYSIOLOGY

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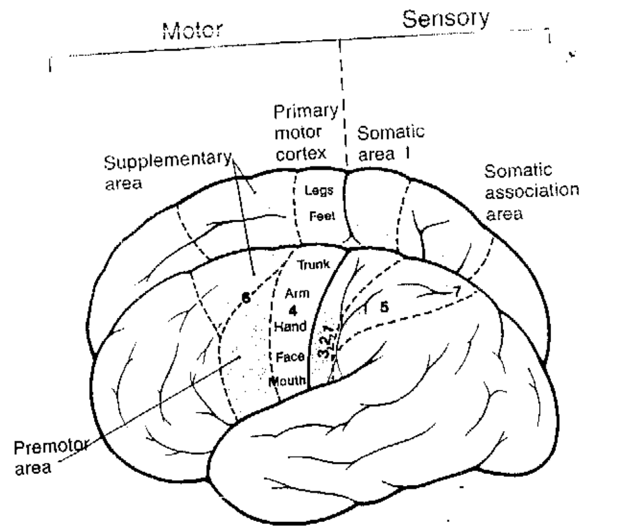

Figure 55–1. Motor and somatosensory functional areas of the cerebral cortex.

the entire primary motor cortex is concerned with controlling the hands and the muscles of speech. Point stimulations in these hand and speech motor areas often cause contraction of a single muscle. But in those areas with lesser degrees of representation, such as the trunk area, electrical stimulation contracts a group of muscles instead.

Premotor Area

The premotor area, also shown in Figure 55–1, lies immediately anterior to the lateral portions of the primary motor cortex, projecting 1 to 3 centimeters anteriorly and extending inferiorly into the sylvian fissure and superiorly about two thirds of the way to the longitudinal fissure; there it abuts the supplementary motor area. The topographical organization of the premotor cortex is roughly the same as that of the primary motor cortex, with the mouth and face areas located most laterally and then in the upward direction the hand, arm, trunk, and leg areas. The premotor area occupies a large share of area 6 in the Brodmann classification of brain topology.

Most nerve signals generated in the premotor area cause patterns of movement that involve groups of muscles that perform specific tasks. For instance, the task may be to position the shoulders and arms so that the hands become properly oriented to perform specific tasks. To achieve these results, the premotor area sends its signals either directly into the primary motor cortex to excite multiple groups of muscles or, more likely, by way of the basal ganglia and then back through the thalamus to the primary motor cortex. Thus, the premotor cortex, basal ganglia, thalamus, and primary motor cortex constitute a complex overall system for control of many of the body's patterns of coordinated muscle activity.

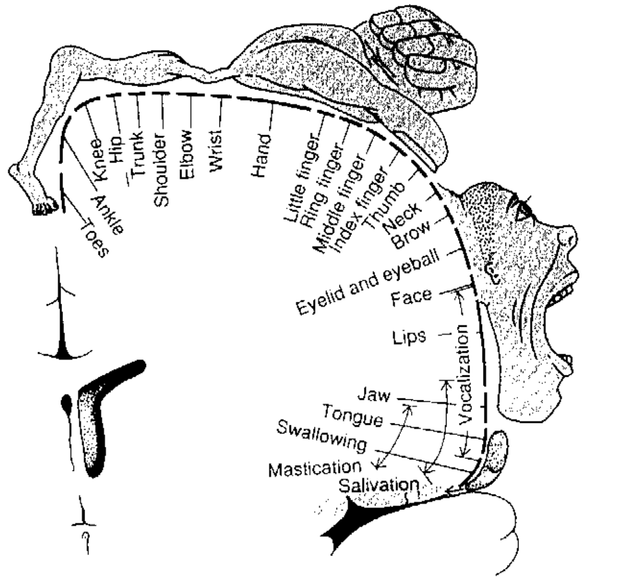

Figure 55–2. Degree of representation of the different muscles of the body in the motor cortex. (From Penfield and Rasmussen: The Cerebral Cortex of Man: A Clinical Study of Localization of Function. New York, Macmillan Co., 1968.)

Supplementary Motor Area

The supplementary motor area has still another topographical organization for control of motor function. It lies immediately superior to the premotor area, lying mainly in the longitudinal fissure but extending a few centimeters over the edge onto the superiormost portion of the lateral cortex.

Considerably stronger electrical stimuli are required in the supplementary motor area to cause muscle contraction than in the other motor areas. When contractions are elicited, they are often bilateral rather than unilateral. For instance, stimulation frequently leads to bilateral grasping movements of both hands simultaneously; these movements are perhaps rudiments of the hand functions required for climbing. Also, there may be rotation of the trunk, rotation of the hands, movement of the eyes, or fixation of the shoulders. In general, this area functions in concert with the premotor area to provide attitudinal movements, fixation movements of the different segments of the body, positional movements of the head and eyes, and so forth, as background for the finer motor control of the arms and hands by the premotor area and primary motor cortex.

Some Specialized Areas of Motor Control Found in the Human Motor Cortex

Neurosurgeons have found a few highly specialized motor regions of the human cerebral cortex, located mainly in the premotor areas, as shown in Figure 55–3, that control specific motor functions. These regions have been localized either by electrical stimulation or by noting the loss of motor function when

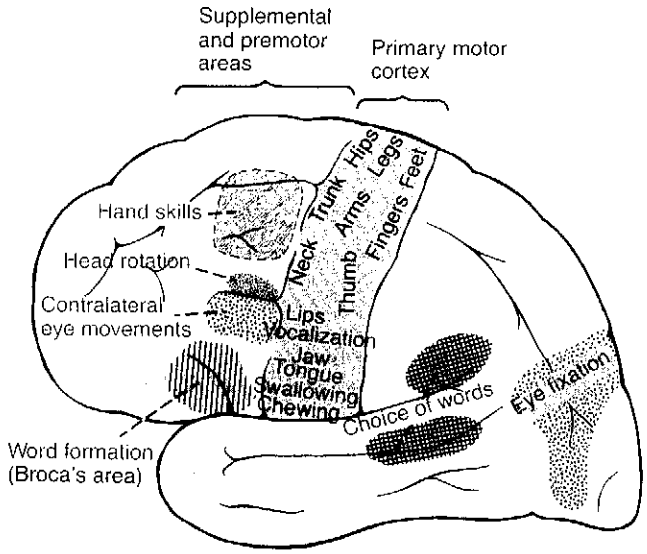

Figure 55–3. Representation of the different muscles of the body in the motor cortex and location of other cortical areas responsible for specific types of motor movements.

destructive lesions have occurred in specific cortical areas. Some of the more important of these are the following.

Broca's Area and Speech. Figure 55–3 shows a premotor area lying immediately anterior to the primary motor cortex and immediately above the sylvian fissure labeled "word formation." This region is called *Broca's area.* Damage to it does not prevent a person from vocalizing, but it does make it impossible for the person to speak whole words rather than incoordinate utterances or an occasional simple word such as "no" or "yes." A closely associated cortical area also causes appropriate respiratory function, so that respiratory activation of vocal cords can occur simultaneously with the movements of the mouth and tongue during speech. Thus, the premotor activities that are related to Broca's area are highly complex.

"Voluntary" Eye Movement Field. Immediately above Broca's area is a locus for controlling eye movements. Damage to this area prevents a person from voluntarily moving the eyes toward different objects. Instead, the eyes tend to lock on specific objects, an effect controlled by signals from the occipital cortex, as explained in Chapter 51. This frontal area also controls eyelid movements such as blinking.

Head Rotation Area. Still slightly higher in the motor association area, electrical stimulation will elicit head rotation. This area is closely associated with the eye movement field and is presumably related to directing the head toward different objects.

Area for Hand Skills. In the premotor area immediately anterior to the primary motor cortex for the hands and fingers is a region neurosurgeons have called an area for hand skills. That is, when tumors or other lesions cause destruction in this area, the hand movements become incoordinate and nonpurposeful, a condition called *motor apraxia.*

Transmission of Signals from the Motor Cortex to the Muscles

Motor signals are transmitted directly from the cortex to the spinal cord through the *corticospinal tract* and indirectly through multiple accessory pathways that involve the *basal ganglia, cerebellum,* and various *nuclei of the brain stem.* In general, the direct pathways are concerned more with discrete and detailed movements, especially of the distal segments of the limbs, particularly the hands and fingers.

Corticospinal Tract (Pyramidal Tract)

The most important output pathway from the motor cortex is the corticospinal tract, also called the *pyramidal tract,* which is shown in Figure 55–4.

The corticospinal tract originates about 30 per cent from the primary motor cortex, 30 per cent from the premotor and supplementary motor areas, and 40 per cent from the somatic sensory areas posterior to the central sulcus. After leaving the cortex, it passes through the posterior limb of the internal capsule (between the caudate nucleus and the putamen of the basal ganglia) and then downward through the brain stem, forming the *pyramids of the medulla.* By far the majority of the pyramidal fibers then cross to the opposite side and descend in the *lateral corticospinal tracts* of the cord, finally terminating principally on the interneurons in the intermediate regions of the cord gray matter but also a few on sensory relay neurons in the dorsal horn, and others directly on the anterior motor neurons that cause muscle contraction.

A few of the fibers do not cross to the opposite side in the medulla but pass ipsilaterally down the cord in the *ventral corticospinal tracts,* but many of these fibers also cross to the opposite side of the cord either in the neck or in the upper thoracic region. These fibers are perhaps concerned with control by the supplementary motor area of bilateral postural movements.

The most impressive fibers in the pyramidal tract are a population of large myelinated fibers with a mean diameter of 16 micrometers. These fibers originate from the *giant pyramidal cells,* also called *Betz cells,* that are found only in the primary motor cortex. These cells are about 60 micrometers in diameter, and their fibers transmit nerve impulses to the spinal cord at a velocity of about 70 m/sec, the most rapid rate of transmission of any signals from the brain to the cord. There are about 34,000 of these large Betz cell fibers in each corticospinal tract. The total number of fibers in each corticospinal tract is more than 1 million, so these large fibers represent only 3 per cent of all of them. The other 97 per cent are mainly fibers smaller than 4 micrometers in diameter that are believed to conduct (a) background tonic signals to the motor areas of the cord or (b) feedback signals from the cortex to control the intensities of various sensory signals going to the brain.