Medical Neuroscience | Tutorial Notes

Finding the Central Sulcus

Map to Neuroscience Core Concepts[1]

NCC1. The brain is the body's most complex organ.

Learning Objectives

After study of the assigned learning materials, the student will:

1. Recognize the central sulcus from its medial terminus in the paracentral lobule to its lateral terminus in the lateral fissure.
2. Sketch the central sulcus in the cerebral hemisphere and label the segments of the pre- and post-central gyri that represent somatic motor control and somatic sensation for the contralateral leg, arm and face.

Narrative

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Overview

When you view the lateral aspect of a human brain specimen (see **Figures A3A** and **A10**[2]), three structures are usually visible: the **cerebral hemispheres**, the **cerebellum**, and part of the **brainstem** (although the brainstem is not visible in the specimen photographed in lateral view for **Fig. 1** below). The spinal cord has usually been severed (but we'll consider the spinal cord later), and the rest of the subdivisions are hidden from lateral view by the hemispheres. The diencephalon and the rest of the brainstem are visible on the medial surface of a brain that has been cut in the midsagittal plane. Parts of all of the subdivisions are also visible from the ventral surface of the whole brain. Over the next several tutorials, you will find video demonstrations (from the brain anatomy lab) and photographs (in the tutorial notes) of these brain surfaces, and sufficient detail in the narrative to appreciate the overall organization of the parts of the brain that are visible from each perspective. As you work through this text and if you have access to an interactive digital atlas of the human brain, such as ***Sylvius4 Online***, find the structures and regions that are described here[3].

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[1] Visit **BrainFacts.org** for *Neuroscience Core Concepts* (©2012 Society for Neuroscience) that offer fundamental principles about the brain and nervous system, the most complex living structure known in the universe.

[2] Figure references to Purves et al., *Neuroscience, 5th Ed.*, Sinauer Assoc., Inc., 2012. [click here]

[3] To do so, launch ***Sylvius4 Online*** and go to **Photographic Atlas**, then select one of the atlas filters, such as **Gyri**, **Lobes**, or **Sulci and Fissures**.

The **cerebral hemispheres** are especially large in humans. They are entirely covered by a 2–3-mm thick layer of cells and cellular processes called the **cerebral cortex**. The surface of each hemisphere is highly infolded; the ridges thus formed are known as **gyri** (singular: gyrus) and the valleys are called **sulci** (singular: sulcus) or **fissures** (if they are especially deep). The appearance of the sulci and gyri varies somewhat from brain to brain. (As you might guess, each one has its own name, but it is necessary to become familiar with only a few of them.) The hemispheres are conventionally divided into lobes named for the bones of the skull that overlie them, namely the **frontal**, **parietal**, **occipital** and **temporal lobes** (see **Figure A3**).

Lateral aspect of the brain

The **central sulcus** is one of the most important landmarks in the human brain for clinicians and neuroscientists because it precisely divides the somatic sensory cortex of the parietal lobe from the motor cortex of the frontal lobe. An appreciation of the structure of the central sulcus—actually, the structure of the gyri that form the central sulcus—will help you understand how the opposite side of the body is represented in the somatic sensory and motor areas that reside in these gyral formations.

Surprisingly, the most reliable way to find the central sulcus is not by inspecting the lateral surface of the brain, where this is one of the longest and deepest sulci of the human cerebral cortex. Rather, the best way to find the central sulcus is to start on the medial surface of the hemisphere. So refer to **Fig. 1** below (see also **Figure A12**) or view the medial surface of the brain using ***Sylvius4 Onine*** and locate the **cingulate sulcus** on the medial surface of the hemisphere. Follow this posteriorly to its marginal ramus, a sharp turn in the sulcus where it ascends to the top of the hemisphere. The sulcus just anterior to the marginal ramus (on the dorsal-lateral surface of the hemisphere) is the central sulcus.

To be certain that the first sulcus anterior to the marginal branch of the cingulate sulcus is the central sulcus, follow the course of the sulcus that you just identified as the central sulcus and you should see that it courses along the lateral surface in a gentle anterior progression as you trace it from the dorsal midline toward its inferior margin (see **Fig. 2** below; see also **Figure A10**). Along the way, note the lazy "S"-shaped bend it takes near the middle of the cerebral hemisphere. With remarkable consistency, that is where the somatic sensory and motor representations of the contralateral arm and hand are localized.

The gyral structure bounded by the marginal branch of the cingulate sulcus on the dorsal midline of the hemisphere is also important; this structure, named the **paracentral lobule**, contains the somatic sensory and motor representations of the contralateral foot. So where's the face represented? Here's another surprise—the contralateral face is localized to the inferior segment of the central sulcus below that lazy "S" shape (not where you might expect it, if the body where mapped contiguously). As you take all of this in, remember: in each of these segments, somatic sensation is represented on the posterior or parietal side of the central sulcus (in the **postcentral gyrus**) and motor control is localized to the anterior or frontal side of the sulcus (in the **precentral gyrus**).

If you have access to ***Sylvius4 Online***, open the Unlabeled image set in the Sectional Anatomy group and view the most dorsal horizontal (axial) section in the set. At this level and plane, the central sulcus is usually the deepest sulcus near the middle of the hemisphere. If you don't have Sylvius4, then refer to **Fig. 3** below, which shows a similar plane of section in a T1-weighted MR image. In either section, notice that in the depths of the central sulcus, there should also be a conspicuous Ω shape (i.e., "omega-shape") formed by an interdigitation of the sulcal walls. This gyral feature is what accounts for the "S" shape that can be appreciated when the central sulcus is viewed from the dorsal-lateral surface of the hemisphere. More importantly, the somatic motor and sensory representation of the contralateral hand invariably includes this distinctive Ω-shape deep in the central sulcus. Evidently, this morphological feature reflects the "over-representation" of the hand in the human brain and the instantiation of this

important functional representation with as much cortical structure as can be packaged into a cramped space. The Ω-shape (which is sometimes called the “hand knob” by neurologists and neuroradiologists) is mainly attributed to a posterior outgrowth of the precentral gyrus, which harbors the primary motor cortex.

Fig. 1. Medial surface of the hemisected human brain. This figure is not labeled so that you may refer to it for review; see Figure A12 for illustrated and labeled views of the same hemisphere. (Image from ***Sylvius4 Onilne***)

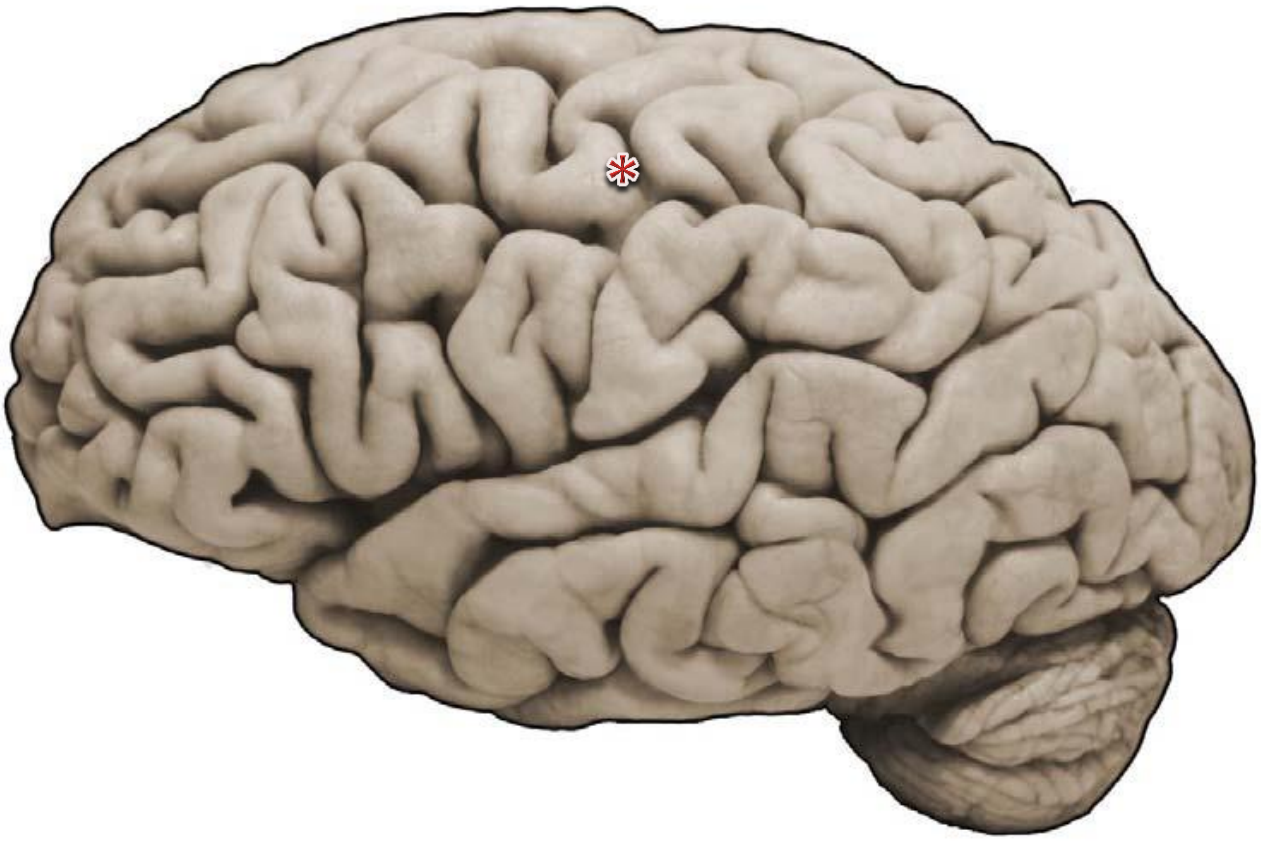

Fig. 2. Lateral surface of the human brain. This figure is not labeled so that you may refer to it for review; see **Figures A3** & **A10** for an illustrated and labeled view of the same hemisphere. The asterisk marks the lazy "S"-shaped bend in the central sulcus near the middle of the cerebral hemisphere. (Image from ***Sylvius4 Online***)

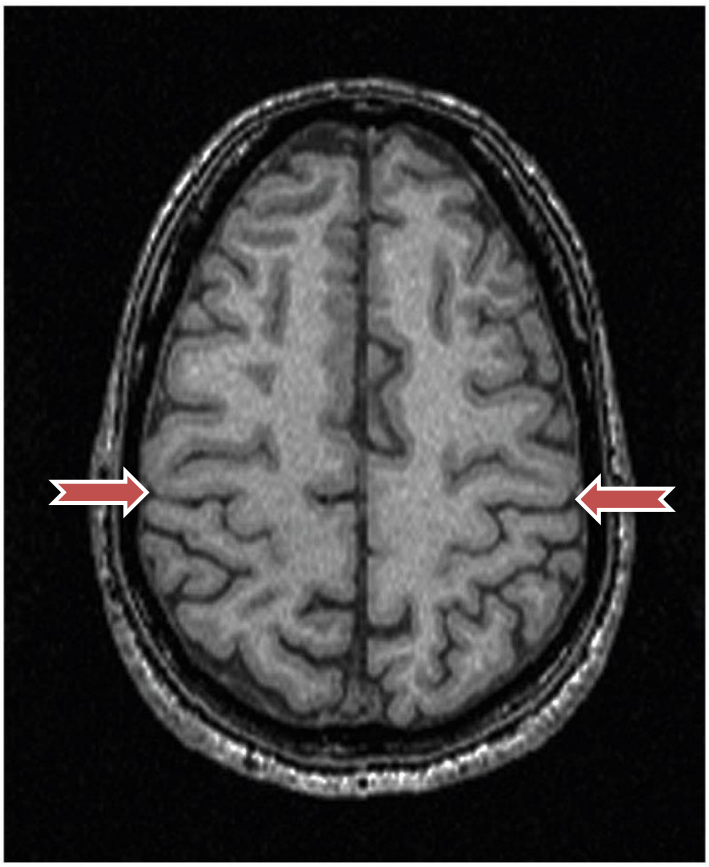

Fig. 3. Axial image through the forebrain acquired with T1-weighted MR imaging (anterior is toward the top). The red arrows identify the central sulcus. (Image from ***Sylvius4 Online***)

STUDY QUESTIONS

Which of the following statements concerning the **central sulcus** is most correct?

A. The central sulcus terminates laterally in or very near the longitudinal fissure.
B. The central sulcus terminates medially in or very near the lateral (Sylvian) fissure.
C. The central sulcus by gyral formations that harbor the primary visual cortex in the human brain.
D. The central sulcus is formed by the growth and morphogenesis of the cuneus gyrus and the lingual gyrus of the cerebral cortex in the human brain.
E. The central sulcus is formed by the growth and morphogenesis of the precentral gyrus and the postcentral gyrus of the cerebral cortex in the human brain.