AJNR

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AJNR Am J Neuroradiol 1993, 14 (2) 349-352
http://www.ajnr.org/content/14/2/349.citation

Limbic System Anatomy: An Overview

Leighton P. Mark,[1,3] David L. Daniels,[1] Thomas P. Naidich,[2] and Jessica A. Borne[1]

The anatomy of the limbic system has become more relevant due to the development of high resolution and functional magnetic resonance (MR) imaging. This review is the first of a series of Anatomic Moments designed to highlight selected features of limbic system anatomy in order to facilitate their application to MR interpretation. Limbic system terminology of early anatomists was largely descriptive (Table 1), but the nomenclature used in this series will follow that of recent authors (Table 2) (1–7).

In accordance with the curvilinear development of the cerebral hemispheres (Fig. 1), the structures of the limbic lobe form a series of "nested")-shaped curves (Fig. 2).

The widest curve is formed by the large limbic gyrus which is designated as 1) the parahippocampal gyrus where it forms the medial-most surface of the temporal lobe, 2) the isthmus of the cingulate gyrus where it lies posterior and inferior to the splenium of the corpus callosum, 3) the cingulate gyrus where it lies superior to the corpus callosum (Fig. 3), and 4) the subcallosal area where it lies inferior to the genu and rostrum of the corpus callosum.

Nested within the limbic gyrus is a long)-shaped sulcus (Fig. 2) designated as 1) the hippocampal fissure where it lies superior to the parahippocampal gyrus, and 2) the callosal sulcus where it lies inferior to the cingulate gyrus (Fig. 3).

Nested within this)-shaped sulcus is another)-shaped structure formed by 1) the dentate gyrus and hippocampus in the temporal lobe (Figs. 2 and 4), 2) the hippocampal tail which consists of thin gray and white matter structures located just posterior and inferior to the splenium of the corpus callosum (Fig. 5), and 3) the supracallosal gyrus which is located inferior to the callosal sulcus. The supracallosal gyrus is intimately applied to the upper surface of the corpus callosum, and contains gray matter termed the indusium griseum (Fig. 3) and thin white matter bundles designated the medial and lateral longitudinal striae.

The smallest)-shaped structure is formed by 1) the fimbria, which is a thin white matter structure that is superior to the dentate gyrus, and 2) the fornix, which forms from the fimbria and then extends anteriorly and inferiorly to reach the mamillary bodies (Fig. 2).

TABLE 1: Limbic system terminology

Amygdala	=	almond shape
Cingulate	=	partly encircling
Dentate	=	teethlike
Fornix	=	archlike
Griseum	=	gray
Hippocampus	=	sea serpent
Indusium	=	membranous, flimsy
Limbic	=	marginal
Uncus	=	hook shape

TABLE 2: The limbic system

Limbic lobe
Limbic gyrus—large gyrus consisting of parahippocampal gyrus, isthmus of the cingulate gyrus, cingulate gyrus, and subcallosal area
Broca's intralimbic gyrus—long gyrus consisting of the hippocampus proper, dentate gyrus, and indusium griseum
Subcortical structures
Amygdala, habenula, mammillary body, septal nuclei, and portions of the thalamus, hypothalamus, and midbrain

[1] Department of Neuroradiology, The Medical College of Wisconsin, Milwaukee, Wisconsin.

[2] Director of Neuroradiology, Baptist Hospital of Miami, Miami, Florida.

[3] Address reprint requests to Leighton P. Mark, MD, Neuroradiology Section, Department of Diagnostic Radiology, Froedtert Memorial Lutheran Hospital, 9200 West Wisconsin Avenue, Milwaukee, WI 53226.

Index terms: Cerebrum; Brain, anatomy; Anatomic moments

AJNR 14:349–352, Mar/Apr 1993 0195-6108/93/1402-0349

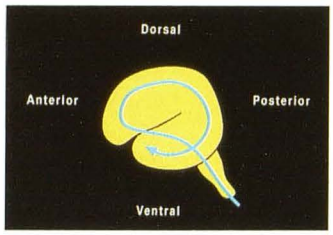
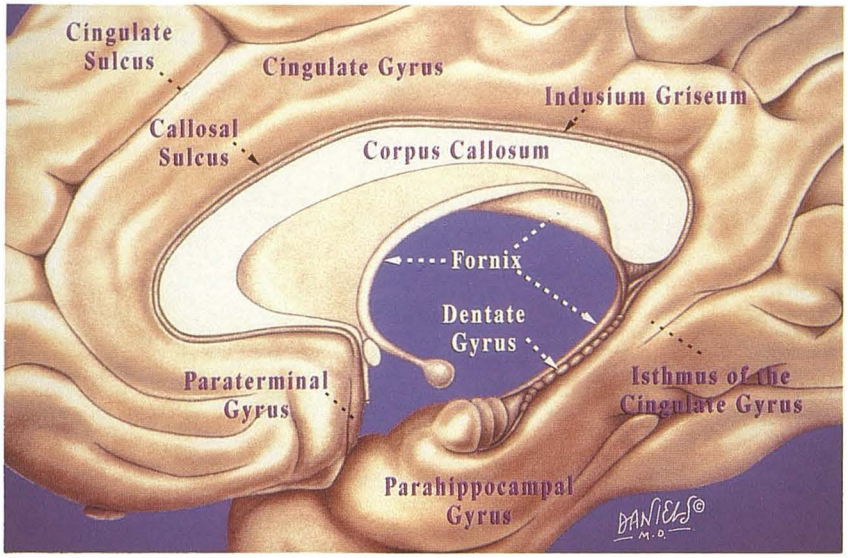


Fig. 1. Schematic showing the curvilinear development of the cerebral hemisphere.



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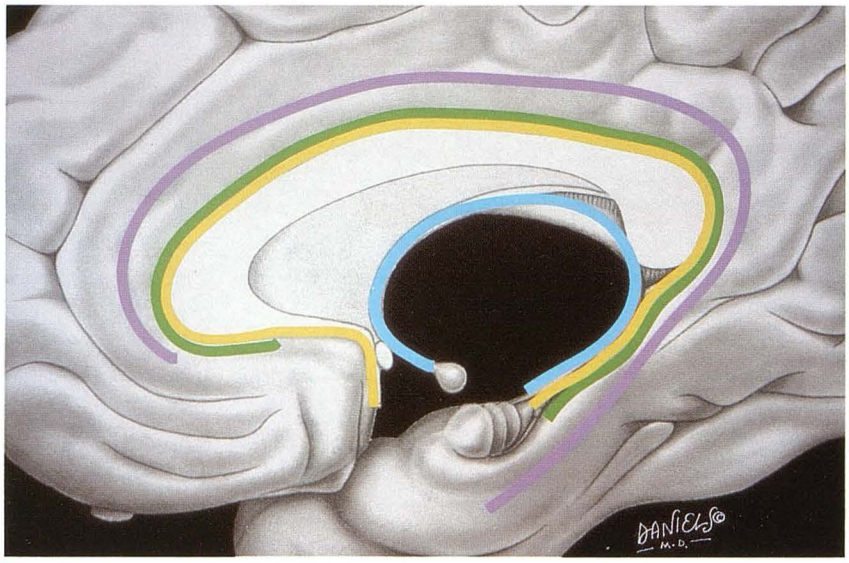

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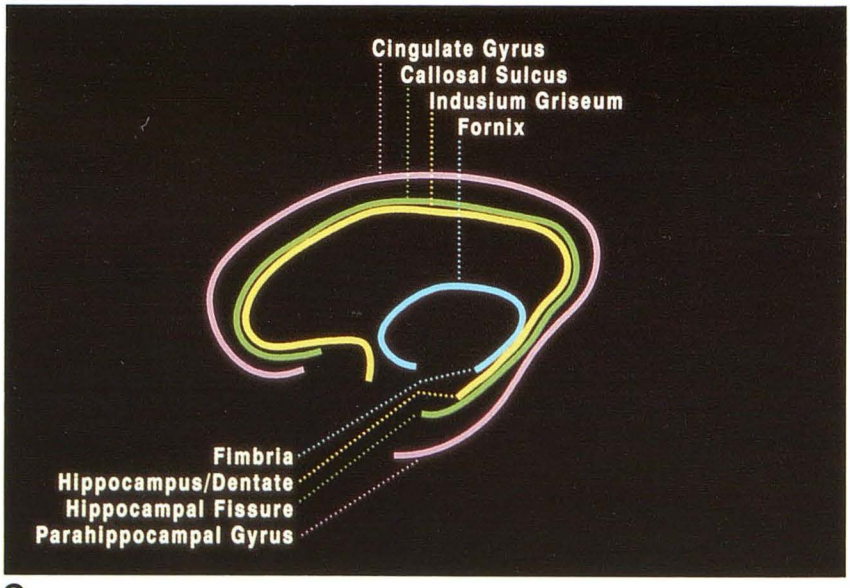

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Fig. 2. *A*, Drawing of the medial aspect of the brain showing components of the limbic area. The thalamic area is not illustrated. (Modified with permission from Nieuwenhuys et al (7).)

B, The limbic lobe can be thought of as a series of "nested")-shaped structures, as illustrated by the colored lines.

C, The parahippocampal gyrus in the temporal lobe is continuous with the cingulate gyrus superior to the corpus callosum (*purple curve*). The hippocampal fissure in the temporal lobe forms the callosal sulcus inferior to the cingulate gyrus above the corpus callosum (*green curve*). The hippocampus and dentate gyrus, which are positioned superior to the hippocampal fissure in the temporal lobe, form the indusium griseum (*yellow curve*) which lie on the superior surface of the corpus callosum but below the callosal sulcus. The innermost curve (*blue curve*) consists of the fimbria giving rise to the fornix. Some of these structures are color-coded in Figures 3–5.

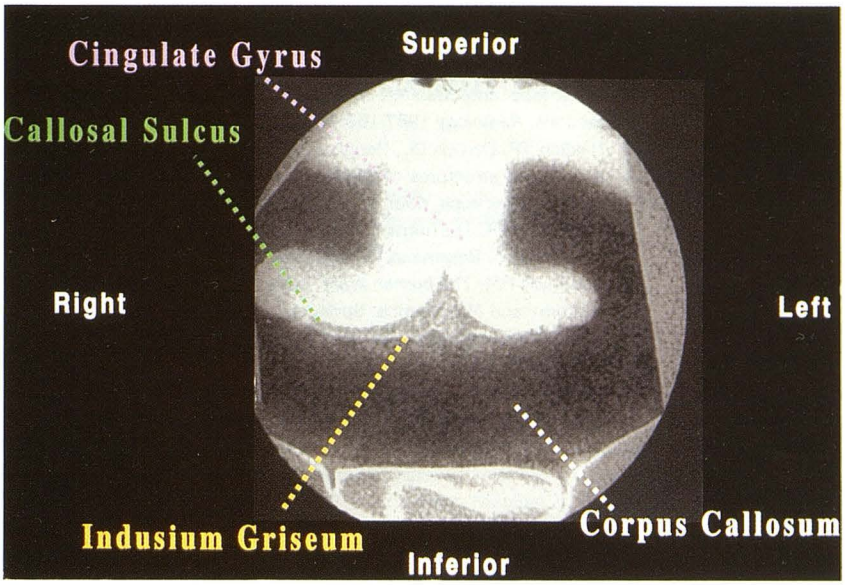

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Fig. 3. The indusium griseum, a very thin layer of gray matter lying on the superior surface of the corpus callosum is shown in a surface coil coronal T2-weighted MR image (field of view = 2) of the corpus callosum of a specimen. The small callosal sulcus lies just above the indusium griseum and below the cingulate gyrus.

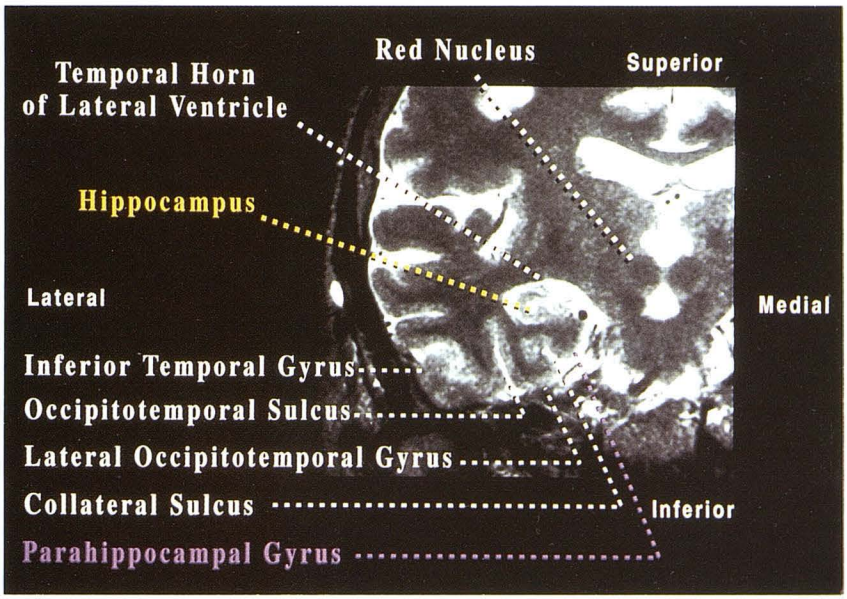

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Fig. 4. An overview of the relationship of the hippocampus to surrounding structures on a routine clinical coronal T2-weighted MR image of the temporal lobe. The hippocampus is readily demonstrated when the coronal image includes the red nucleus. The hippocampus is positioned immediately inferior to the temporal horn of the lateral ventricle. The anatomy of the inferior surface of the temporal lobe is also consistently shown on coronal images. The parahippocampal gyrus, which forms the most medial aspect of the inferior surface of the temporal lobe, is separated from the lateral occipitotemporal gyrus by the collateral sulcus. The occipitotemporal sulcus separates the lateral occipitotemporal gyrus from the inferior temporal gyrus, which also forms the inferiormost aspect of the lateral surface of the temporal lobe.

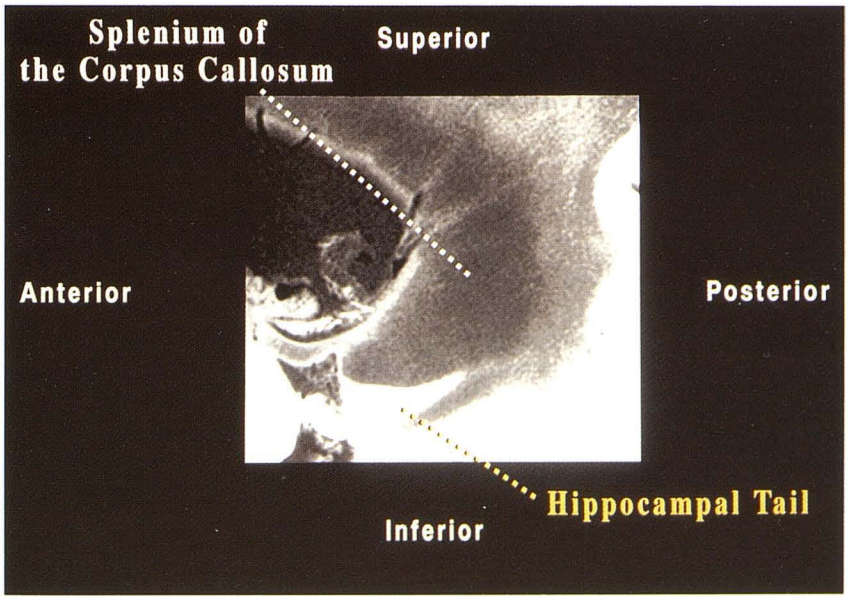

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Fig. 5. The hippocampal tail is seen as a triangular wedge of gray matter located immediately inferior to the splenium of the corpus callosum in a surface coil sagittal T2-weighted MR image (field of view = 3) of a specimen. The hippocampal tail extends around the splenium to form the indusium griseum just above the corpus callosum.

Acknowledgment

We would like to thank Diane McCain of Medical Center Graphics in Milwaukee, Wisconsin, for her help in the computer manipulation of the images.

Suggested Readings

1. Carpenter MB, Sutin J. *Human neuroanatomy*. 8th ed. Baltimore: Williams & Wilkins, 1983
2. Naidich TP, Daniels DL, Haughton VM, Williams AL, Pojunas K, Palacios E. Hippocampal formation and related structures of the limbic lobe: anatomic-MR correlation. I. Surface features and coronal sections. *Radiology* 1987;162:747–754
3. Naidich TP, Daniels DL, Haughton VM, et al. Hippocampal formation and related structures of the limbic lobe: Anatomic-MR correlation. II. Sagittal sections. *Radiology* 1987;162:755–761
4. Duvernoy HM. The human hippocampus: an atlas of applied anatomy. Munich: J. F. Bergmann Verlag, 1988
5. Duvernoy HM. *The human brain*: surface, three-dimensional sectional anatomy and MRI. Vienna: Springer-Verlag, 1991
6. Bronen RA. *Hippocampal and limbic terminology*. *AJNR: Am J Neuroradiol* 1992;13:943–945
7. Nieuwenhuys R, Voogd J, Van Huijzen Chr. *The human central nervous system: a synopsis and atlas*. 3rd revised ed. 1988