The Collateral Sulcus as Landmark for the Parahippocampal Cortex

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Introduction

The collateral sulcus lies within the ventromedial surface of the human temporal lobe, where the entorhinal, perirhinal and parahippocampal cortical areas are located. It has been described as a single sulcus [1, 2], however, in the rostrocaudal direction, the collateral sulcus appears to separate into two components (see Figs. 1-3). This division may correspond to the anterior limit of the parahippocampal cortex [3]. The purpose of the present study was to examine the course and variability of the separation of the collateral sulcus into an anterior and a posterior branch.

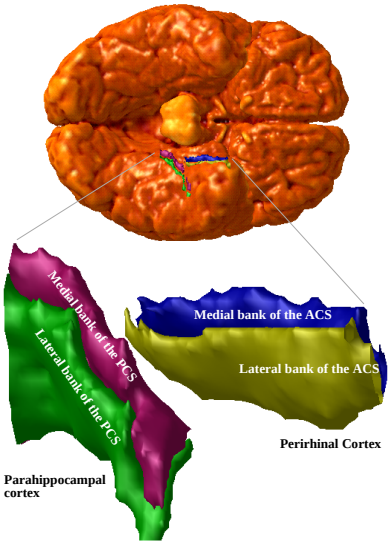

Figure 1: 3-D reconstruction of a brain (bottom view) showing the location of the collateral sulcus segmented and enlarged. This example shows a division within the collateral sulcus separating it into the anterior and posterior collateral sulci (ACS, PCS).

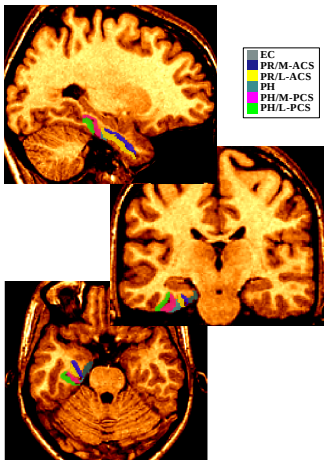

Figure 2: Sagittal, coronal, and horizontal sections from the segmented brain shown in Fig.1. The sagittal sections shows the course of the ACS and PCS. The coronal section shows the ACS and PCS side by side. The horizontal section clearly shows that the ACS and PCS are separate. Icbm brain 100; x=-27, y=-22, z=-25. EC: entorhinal cortex, PR: perirhinal cortex, PH: parahippocampal cortex, M: medial bank of the sulcus, L: lateral bank of the sulcus.

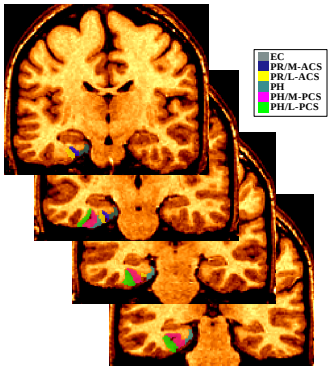

Figure 3: Successive coronal sections, going towards the back of the brain from top to bottom, showing the gradual appearance of the PCS. Icbm brain 100; y=-18, -22, -26, -30. See Fig. 2 for a description of the legend.

Methods

The anatomy of the collateral sulcus was studied in 25 normal brains that were scanned with a Philips Gyroscan 1.5 Tesla, using a 3-D fast field echo acquisition sequence T1-weighted. The resulting structural Magnetic Resonance Images (MRIs) were transformed into standard stereotaxic (Talairach [4]) space in order to control for differences in brain size [5]. Each brain was examined by identifying the collateral sulcus at the level of the amygdala in coronal sections (approximately Y=0) and following its course to the posterior limit of the hippocampus (approximately Y=-50). The shapes of the collateral sulci were classified into four different categories (see Figs. 4-7). The lateral bank of the anterior collateral sulcus was then segmented with a locally developed image analysis tool called Display, and a SPAM (structure probability anatomy map) [6] of the segmented structures was created (Fig. 9).

Results

The four categories in which the CS were classified are illustrated below (Figs. 4-7)with the percentage of occurrence in each hemisphere. By following the coronal sections, from top to bottom, one can observe the changes described. The histogram (Fig. 8) and statistical map (Fig. 9) show the distribution of the ACS accross all brains.

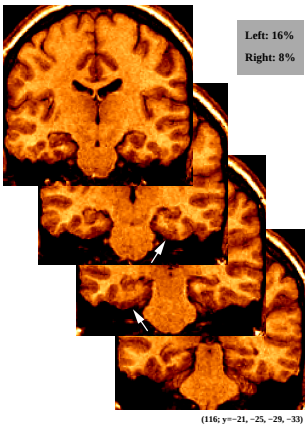

Figure 4: The ACS disappears (see arrows) before the PCS appears.