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Anatomy

The Major Sulci of the Cerebral Cortex Variations: A Report of 6 Cases

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Abstract **Case report**

The human brain is divided into four lobes by four major sulci including the lateral, central, parieto-occipital, and calcarine sulci. These sulci were used as landmarks for the brain's higher functional areas and during brain surgical entrances. According to the previous reports the variants of these main sulci were founded. The current study aimed to show a case report about the variant of the main sulci for the human brain. This study was managed on the plastinated human brain samples during the dissection room training for medical students in the medical college at Najran University in Saudi Arabia. Our study showed that there are abnormalities in the direction and distributions of the main sulci of the brain cortex a rare case. Therefore, our findings can help surgeons to understand the sulci course and their subdivision areas on the cerebral cortex to do their procedures.

Keywords: Major, sulci, cerebral, cortex, variations.

INTRODUCTION

The cerebral cortex main sulci include central, lateral, parieto-occpital and calcarine sulci were studies. The central sulcus or fissure of Rolando separates the frontal lobe of the cerebrum from the parietal lobe and extended from the superior medial surface of the cerebrum, then run downward and forward on the lateral aspect of the cerebral cortex to end slightly above the lateral sulcus. The lateral sulcus or fissure of Sylvius expanded on the inferolateral aspect of the cerebral cortex, it's beginning between the anterior borders of the lower frontal and upper temporal lobes, and gives branches as the anterior transverse ramus and the anterior ascending ramus and continuous posteriorly as the posterior ramus to separate the frontal and parietal lobes from the temporal lobe. Parieto-occipital sulcus separates the parietal lobe from the occipital lobe and extended from the superior medial surface of the cerebral cortex about 5 cm anterior to the occipital pole, it is directed inferiorly and anteriorly to end at the calcarine sulcus. The calcarine sulcus is located on the medial aspect of the occipital lobe, and it begins close to the posterior end of the corpus callosum and extends upward and backward to end at the occipital pole of the cerebral cortex (Snell RS, 2010). Some previous studies reported some variations on major sulci of the brain cortex and their benefits for neurological surgeons (Chauhan P *et al.*, 20 21; Galaburda and Schmitt, 2001). This case report aimed to understand the variations in the central, lateral, and parieto-occipital sulci of the cerebral hemisphere.

A report of 6 Cases

Throughout the study of the male human plastinated brain cerebral hemisphere (age ranged between 27 to 51 years) for medical students in the dissection room of the anatomy department, faculty of medicine, Najran University, Saudi Arabia, however, an ethical permission is taken before the study begins, and we observed the following 6 cases of the major sulci of brain cortex variations:

1. The upper part of the central sulcus of the right cerebral hemisphere crossed the lateral sulcus (Figure 1).
2. The superior part of the central sulcus ended at the superior aspect of the cerebral cortex (Figure 2).
3. The lateral sulcus of the right cerebral hemisphere presented one posterior ascending ramus, and one posterior descending ramus (Figure 3).
4. The lateral sulcus presented three posterior ascending rami (Figure 4).
5. The parieto-occipital sulcus of the right cerebral hemisphere begins from the superior medial surface of the cerebrum and directed downward and posteriorly then anterior inferiorly and joined

the calcarine sulcus on the medial surface (Figure 5).

6. The calcarine sulcus on the right cerebral hemisphere presented two short horns sulci (superior and inferior) at its end on the occipital pole (Figure 6).

Figure 1: Showed the central sulcus variant of the right cerebral hemisphere; 1= showed the variant of the upper end of the central sulcus on the superior aspect of the cerebral hemisphere

Figure 2: Showed the central sulcus variant of the right cerebral hemisphere; 1= central sulcus across the lateral sulcus, 2= lateral sulcus

Figure 3: Showed the lateral sulcus variants of the right cerebral hemisphere; 1= anterior ascending ramus, 2= horizontal ramus, 3= posterior ramus, 4= posterior ascending ramus, 5= posterior descending ramus

Figure 4: Showed the lateral sulcus variants of the left cerebral hemisphere; 1= posterior ramus, 2= first posterior ascending ramus, 3= second posterior ascending ramus, 4= third posterior ascending ramus, 5= horizontal ramus, 6= anterior ascending ramus

Figure 5: Showed the parieto-occipital sulcus variants of the right cerebral hemisphere; 1= parieto-occipital sulcus, 2= calcarine sulcus ramus

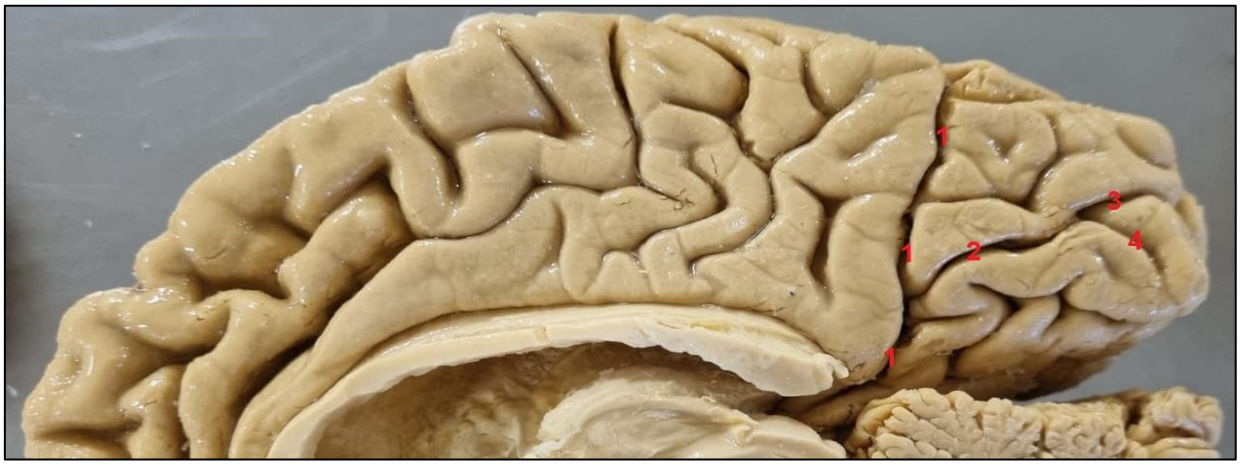

Figure 6: Showed the calcarine sulcus variant of the right cerebral hemisphere; 1= parieto-occipital sulcus, 2= calcarine sulcus ramus, 3= superior horn of calcarine sulcus, 4= inferior horn of calcarine sulcus

DISCUSSION

The current case report revealed variations in the appearance course of the major sulci of the cerebral cortex and these sulci include the central, lateral, parieto-occipital, and calcarine. Therefore, the sulci variations can help neurologists to understand how they

applied and repair the brain cortex problems. The main neuroanatomical references showed that the central sulcus separates the motor frontal lobe from the sensory parietal lobe of the cerebral hemisphere and ends slightly above the midpoint of the lateral sulcus, the lateral sulcus separates the frontal and parietal lobes from the temporal lobe and presented one ascending ramus, one horizontal ramus, and one posterior ramus, the parieto-occipital sulcus separates the parietal lobe from the occipital lobe and begins on the upper part of the cerebral cortex and descending downward and anteriorly to join the calcarine sulcus on the medial aspect of the occipital lobe, and the calcarine sulcus located on the medial surface of the occipital lobe and end close to the pole of the occipital lobe (Chauhan P *et al.*, 2021). In this case reports the variables are: the central sulcus crosses the lateral sulcus, the lateral sulcus presented more than one posterior ascending ramus as well as one anterior descending ramus, the parieto-occipital sulcus course is directed downward and backward from the beginning part and joins the calcarine sulcus, and the calcarine sulcus presented two horns close to the occipital lobe pole.

The cerebral hemisphere and its major sulci arise at the beginning of the fifth week during the fetal developmental period and the large brain sulci may be affected and make some variability such as the short growth in length of the central sulcus is associated with Williams syndrome (Galaburda and Schmitt, 2001) and the abnormal pattern of the major brain sulci caused by a viral infection called congenital Zika syndrome (Sadler TW, 2019).

The other factor associated with brain sulci variations is that the central sulcus arrangement is different in comparison between males and females and a previous study demonstrated that it's most ascendant in males than females (Sun B *et al.*, 2015). The long-term motor activity also can affect the pattern of the central sulcus such as in musicians (Li S *et al.*, 2010). A study on the Bangladesh population showed that their central sulcus gradational declining character with advancing age (Jabeen L et *al.*, 2021). A previous report was done and demonstrated that significant deferent were found between gender according to their anterior ascending and horizontal rami of the lateral sulcus (Wang Y *et al*, 2022). The straight course of the parieto-occipital sulcus was the most common (Gurer *et al*., 2013), but the difference was found in the current report in that the parieto-occipital sulcus was not straight, and its deviated posterior and downward then anteriorly to joining the calcarine sulcus. Therefore, in the people who suffer from schizophrenia and migraine headache disease, the parieto-occipital pattern showed an abnormal shape in comparison to the healthy people (Sulejmanpasic *et al.*, 2016). A study was done on the calcarine sulcus shape of adult Bangladesh people and presented that the length was decreased in old age than in younger (Jabeen L *et al.*, 2021). Conducted study of the course behavior of the calcarine sulcus was showed that all calcarine sulcus crosses the parieto-occipital sulcus (El Mohamad *et al.*, 2019), and these findings corresponded to our reports.

CONCLUSION

This study summarized that there are some differences in the shape and arrangement of the major sulci of the brain cortex and these findings can benefit neurosurgeons in understanding the variations that can exist in the brain compared to the common normal ones for taking the necessary measures during the performance of brain surgeries.

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