

Anatomical Variations within the Insular Gyri

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INTRODUCTION

The insula participates in many brain functions such as modulation of the autonomic nervous system activity or pain and sensation. Knowledge of gyral and sulcal organization of the insula is important for diagnosis and functional MR imaging. Three-dimensional locations of gyral landmarks vary between different individuals, that may be crucial during local landmark-based mapping of human cortex. The aim of the study was to clarify the classification criteria of the morphologic variability of the human insula.

MATERIAL AND METHODS

The study was conducted on 35 isolated, randomly selected adult cadaveric hemispheres, fixed in 10% formaline and preserved in 70% ethanol solution (18 left and 17 right hemispheres). A thorough rating system of insular anatomy was adapted to analyze insular gyri – including bifid gyri (Fig. 1), their branching (Fig. 1, Fig. 2) or hypoplasia (Fig. 2).

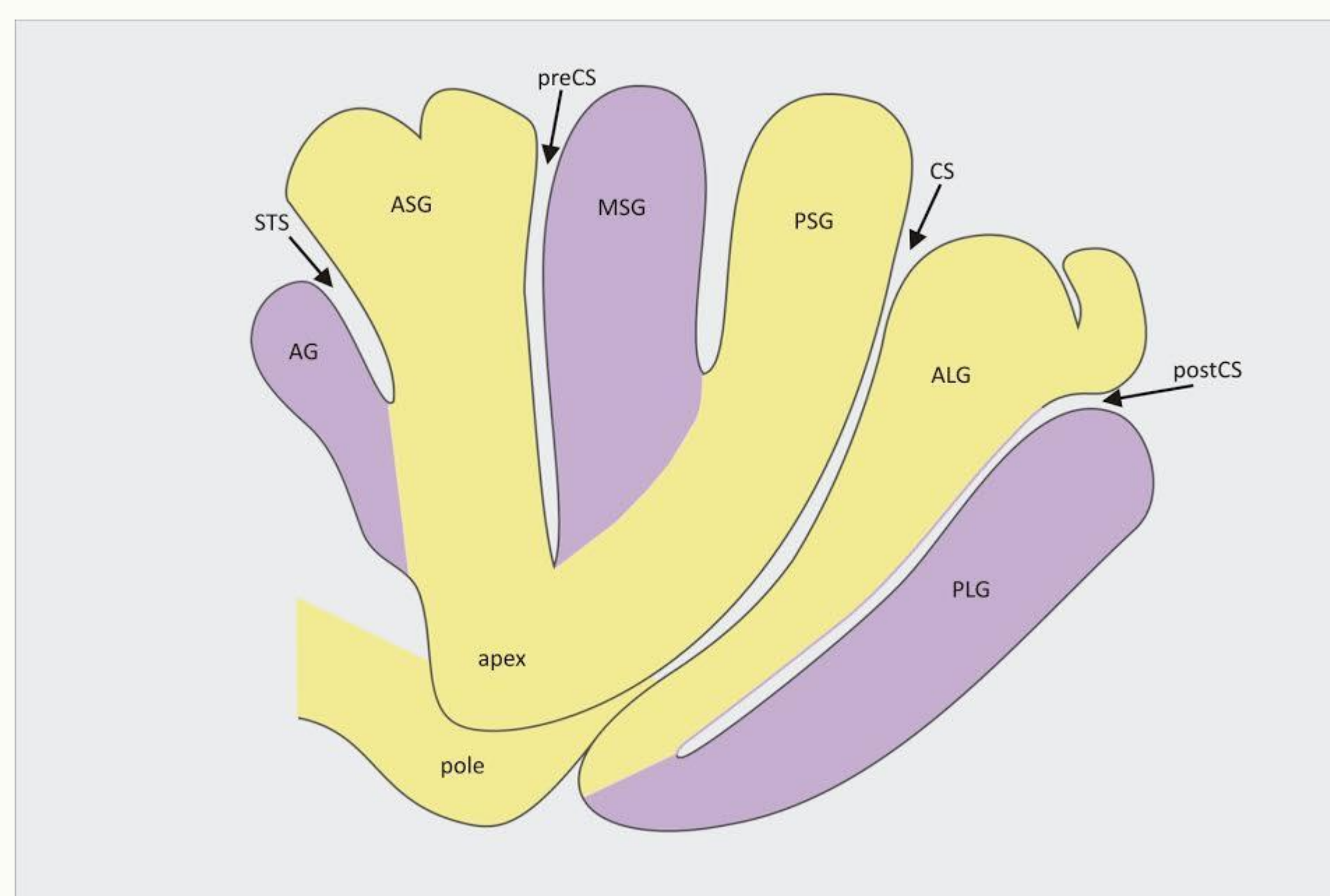


Fig. 1. Classification of insular gyri. The gyrus was classified as bifid on its upper end (see ASG) when the sulcus along the length of the gyrus extended up to 30% inferiorly. When a sulcus extended between 30% and 50% inferiorly, it delineated a bifid gyrus (see MSG branching from PSG or AG branching from ASG). A novel gyrus was delineated by a sulcus that extended more than 50% inferiorly (see PLG as separate gyrus). STS – short insular sulcus, preCS – precentral sulcus, CS – central insular sulcus, postCS – postcentral sulcus. AG – accessory gyrus, ASG – anterior short gyrus, MSG – middle short gyrus, PSG – posterior short gyrus, ALG – anterior long gyrus, PLG – posterior long gyrus

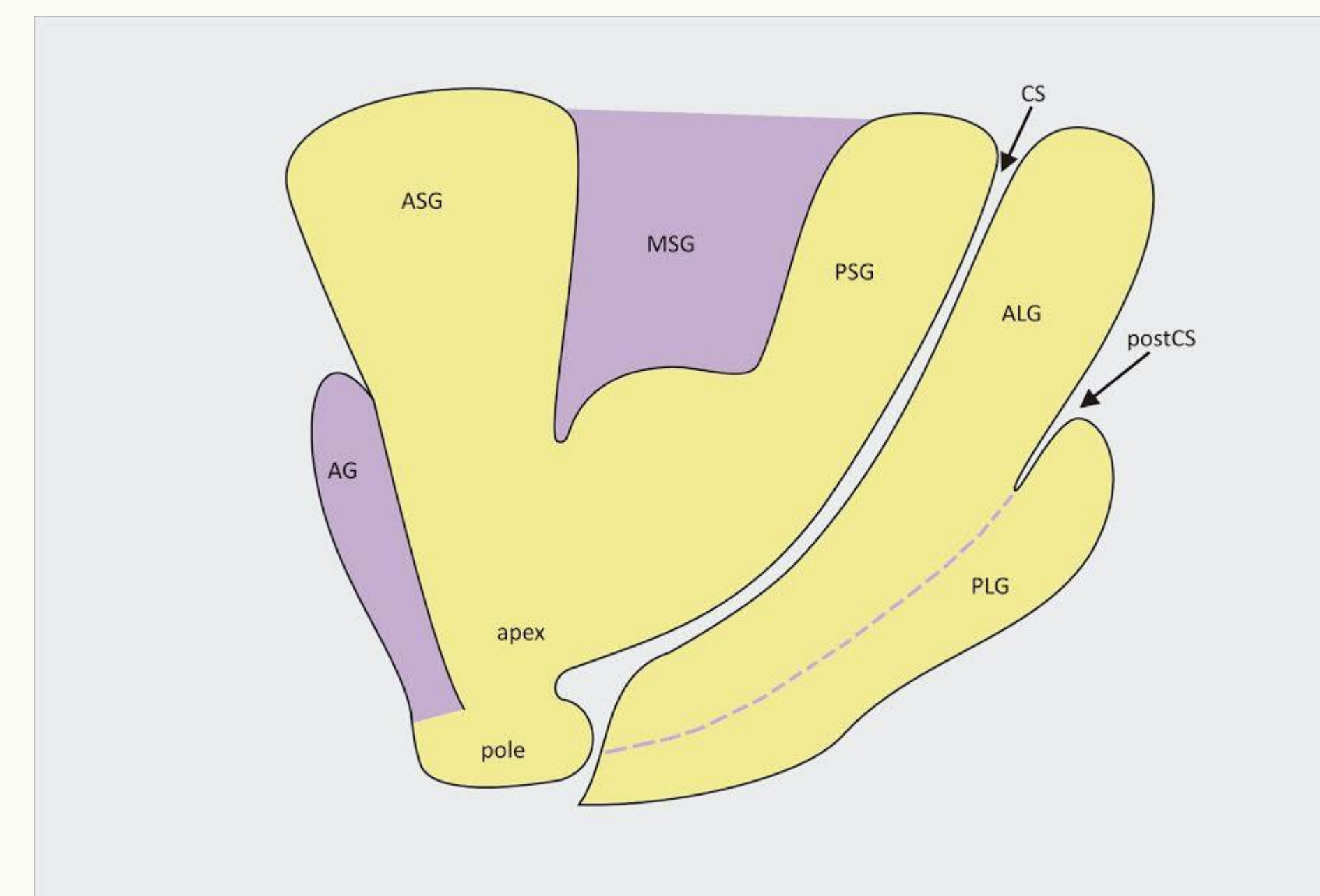


Fig. 2. Classification of insular gyri. Middle short gyrus (MSG) may be depressed below the convexity surface of the insula or may be hypoplastic. Posterior long gyrus (PLG) is shown branching from the anterior long gyrus (ALG). CS – central insular sulcus, postCS – postcentral sulcus, AG – accessory gyrus, ASG – anterior short gyrus, PSG – posterior short gyrus

RESULTS

The number of all insular gyri ranged from 4 to 7 (mean=5.17, SD=0,62). Within the anterior lobule the number of short gyri oscillated from 2 to 5 (mean=3.26, SD=0.51). The middle short gyrus was more variable (Fig. 3). It was well-developed in 17 out of 35 cases (48,57%) – see Fig. 3a. In 14 out of 35 cases (40%) the middle short gyrus was depressed below the convexity surface of the insula and in 4 out of 35 cases (11,43%) it was hypoplastic (Fig. 3c). The accessory gyrus was well developed and reached the convexity surface of the insula forming its first gyrus in 13 hemispheres (37,14%) – see Fig. 3a and 3c. Within the posterior lobule the number of long insular gyri was from 1 to 2 (mean=1.91, SD=0,28). In 34 cases (97,14%) the anterior long gyrus was well developed. The posterior long gyrus was complete and distinctly separated from the ALG throughout its course in 18 out of 35 cases (51,43%) – see Fig. 3a. In all other cases the posterior long gyrus branched from anterior long gyrus, resembling a posteriorly directed “outgrowth” from its back – see Fig. 3c. Complete lack of the posterior long gyrus was noted in 3 out of 35 cases (8,57%).

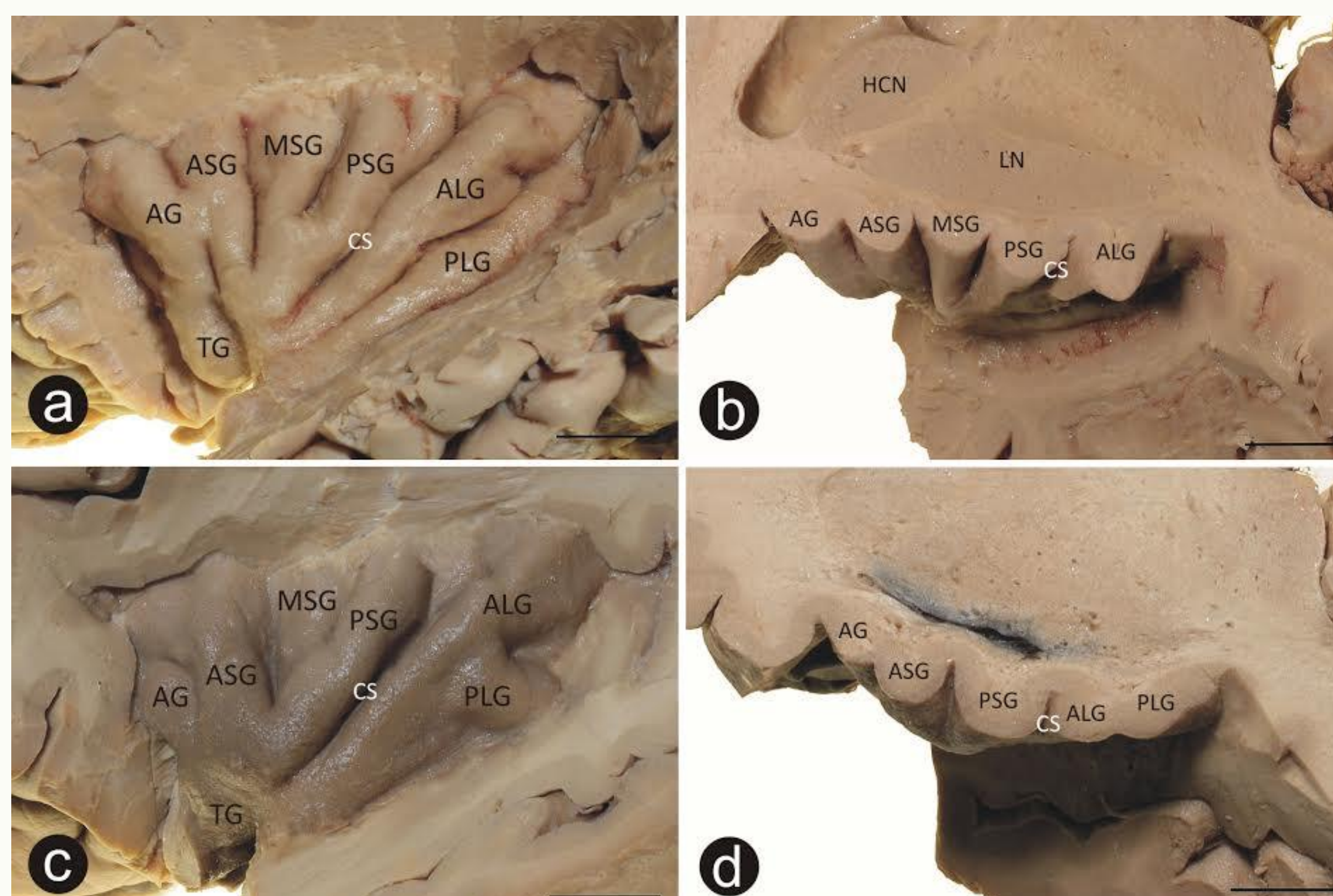


Fig. 3. Variable morphology of insular gyri. a – Presence of well developed accessory gyrus (AG) forming the first gyrus within anterior lobule of the insula. b – Horizontal section of the hemisphere previous seen at fig. a. However, not every gyrus is exposed in this view. c – Hypoplastic middle short gyrus (MSG). Posterior long gyrus (PLG) branching from anterior long gyrus (ALG) within the posterior lobule of the insula. d - Horizontal section of the part of the hemisphere previous seen at fig. c. Not every gyrus is exposed in this view. CS – central insular sulcus, ASG – anterior short gyrus, PSG – posterior short gyrus, ALG – anterior long gyrus, TG – transverse gyrus, HCN – head of caudate nucleus, LN – lentiform nucleus

CONCLUSIONS

The most variable were the accessory, the middle short and the posterior long gyri of the insula. The amount of insular gyri assessed on horizontal section of the brain may not reflect their total number.