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METHODOLOGY OF MEASURING BROCA'S AREA: PHYSICAL MEASUREMENT ANALYSIS

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Actuality. Broca's area, in the left inferior frontal gyrus, is vital for speech and language. Studies show females have up to 20% larger relative surface area than males, with MRI confirming anatomical differences, suggesting structural advantages linked to sex-related verbal ability and connectivity variations.

Aim: this thesis seeks to critically assess the methodologies used for measuring Broca's area, supporting prior research on gender-specific variations in its surface area relative to total brain size, observed laterally. The objective is to strengthen the link between brain anatomy and neurofunctional capabilities across genders.

Materials and methods. The methodology employed measuring tapes, vernier callipers, and augmented reality tools to reduce errors from the brain's complex surfaces. These tools provided a preliminary framework, despite anatomical variability. Ten brain specimens from BSMU's Anatomy Department, without demographic data, were studied. Broca's area, in the frontal lobe's inferior frontal gyrus (pars opercularis, Brodmann area 44; pars triangularis, Brodmann area 45), was identified anterior to the precentral sulcus, near the motor cortex. Seven measurements assessed Broca's area: vertical length from its top to the parietal lobe's top (V1); top to lower border, perpendicular to the lateral sulcus (V2); horizontal distance from frontal lobe's tip to central sulcus (H1); tip to Broca's lateral border (H2); lateral border to central sulcus, toward temporal lobe (H3); total brain length (Hmax) and height (Vmax).

Results and their discussion. Analysis of seven measurements across ten specimens revealed significant variability in Broca's area dimensions: V1 (2.97–5.92 cm), V2 (2.88–3.64 cm), Vmax (6.82–10.92 cm), H1 (9.33–11.12 cm), H2 (2.31–3.22 cm), H3 (2.94–4.21 cm), and Hmax (13.94–17.14 cm). This heterogeneity reflects individual neuroanatomical differences, particularly in sulcal patterns and gyrification. V1's wide range suggests variability in Broca's superior border, while V2 indicates differences in its vertical span. Horizontal measurements (H1–H3) reveal positional diversity relative to frontal and temporal lobes. Total brain dimensions (Hmax, Vmax) contextualise scaling, relevant to studies reporting proportionally larger Broca's areas in females. While manual tools (callipers, tapes) provided foundational 2D data, their limitations—such as landmark subjectivity and curvature errors—highlight MRI/CT's superiority for volumetric analysis. The lack of demographic data precludes direct gender comparisons, but seen variability aligns with literature linking Broca's morphology to language function. These findings support the utility of low-cost methods for preliminary assessments, though advanced imaging remains critical for structure-function correlations. The study underscores the need for standardised protocols in neuroanatomical research.

Conclusion. These measurements estimate Broca's area surface area, enabling comparisons with averages. The data supports gender-based research, linking size variations to neurological functions. Low-cost tools aid preliminary assessments, but MRI/CT excels for volumetric precision in studying language processing structure-function relationships.