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Original Research Article

MORPHOGENSIS OF SULCI ON SUPEROLATERAL SURFACE OF HUMAN FOETAL BRAIN OF DIFFERENT GESTATIONAL AGE

Gayatri. N *[1], Nagaraj. S [1], D. Suseelamma [2], Anil. R. Sherke [3].

*[1] Assistant Professor, Department of Anatomy, Kamineni institute Of Medical sciences, Narketpally, Narketpally, Talangana, India.

[2] Professor and Head of the Department Anatomy, Mamatha Medical College, Khammam, Talangana, India.

[3] Professor and Head of the Department Anatomy, Kamineni institute Of Medical sciences, Narketpally.

ABSTRACT

Background: During intrauterine life brain surface is smooth up to 14th week. The cortical maturation and vascularisation of lateral surface of the brain starts with the insular region, suggesting that this region is the central area of cortical development between temporal and frontal lobe. Delayed sulcation during pregnancy leads to agenesis of corpus callosum along with additional brain abnormality.

Materials: This study was conducted on 50 dead foetuses in anatomy department brought from the department of Obstetrics and gynaecology.

Results: Brain is divided into two half by appearance of median longitudinal fissure between 12-14weeks. The surface of each cerebral hemisphere is smooth up to 4th month, later surface depression appears on the supero lateral surface at 5th month. Growth of adjoining lobes of brain make surface more convoluted ,and at 6th month sulcus make their appearance .All important sulci are laid down by the end of 7th-8th month.

Conclusion: There is no differences between male and female brains of same gestational age. Knowledge of the sulci enlightens us regarding treatment and protection of vital structures.

KEY WORDS: Cortical maturation, Sulci, Gestational age, Foetal brain.

Address for Correspondence: Dr. Gayatri. N, Asst. Professor of Anatomy, Kamineni Institute of Medical sciences, Narketpally-508254, Dist.-Nalgonda, Telangana, India
Mobile no.: +919866084854. **E-Mail:** drgayatri1884@gmail.com

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INTRODUCTION

The surface of the cerebral hemisphere shows a complex patter of convolutions, which are separated by furrows of varying depth known as fissures or sulci [1]. They partly provide the basis for divisions of hemisphere into lobes [2]. The frontal, parietal, temporal and occipital lobes, approximately correspond in surface extent to the cranial bones from which they take their names [3]. The classification of these sulci is an important step in neuroimaging studies, which seek to analyse morphological changes in the regions of interest on the cortex [1]. Brain

matures in an organised, predetermined pattern that correlates with the function, the new born or infant performs at various stages of development .It develops rapidly between 5th week to the end of 12th week of intrauterine life at various stages of development [4]. Knowledge of it guides us regarding the morphological and functional changes of developing brain in terms of treatment and protection of vital structures [5].

MATERIALS AND METHODS

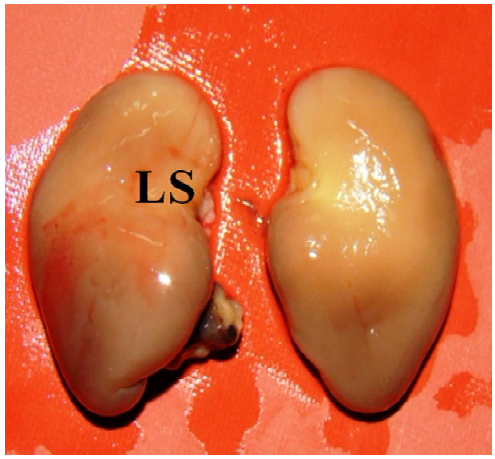
The present study was conducted in Kamineni Institute of Medical Sciences, Narketpally .50 dead foetuses/stillbirth of various cause are collected from department of Obstetrics and gynaecology .Foetal brain is embalmed with concentrated 40% formalin and dissected after 48 hours. Gestational age of the dead foetuses is calculated by Crown - rump length, Biparietal diameter, Head circumference, abdominal circumference [6] and grouped into 5 groups with an interval of 6 weeks.

Brain is removed with dissection method [7]. Skin of the scalp is reflected in four flaps, later followed by reflecting the membranous vault bones again in four flaps, dura is cut and opened in four flaps. The falx cerebri is cut from crista galli and pulled back with one hand while the palm of other hand supports the brain from posterior aspect. Frontal lobes are gently separated and lifted back from anterior cranial fossa, olfactory bulbs are separated from cribriform plate of ethmoid, and later optic nerves are cut close to optic foramina, later brain is detached from spinal cord by cutting at foramen magnum and examined macroscopically for description of sulci.

Table 1: Gender wise distribution of number foetuses into 5 groups

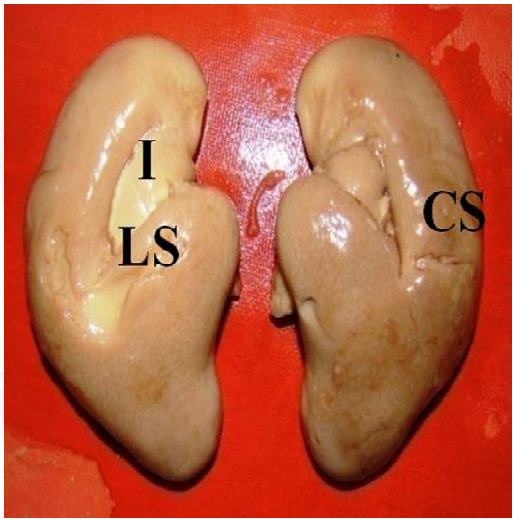
Group	Gestational age (weeks)	Female	Male	Total no of foetuses (n)=50
Group -1	Dec-18	5	7	12
Group -2	>18-24	5	8	13
Group -3	>24-30	7	9	16
Group -4	>30-36	3	3	6
Group- 5	>36-40	1	2	3

Fig. 1: Showing the surface of brain in GROUP-1 (12-18wks).



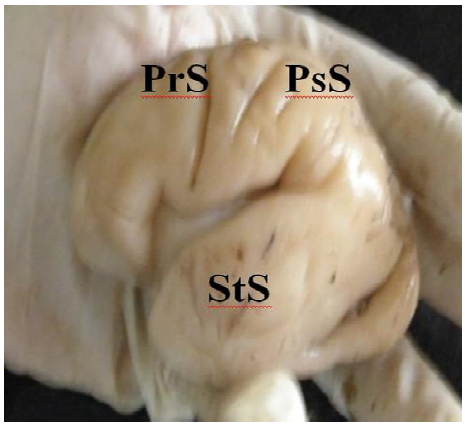
Lateral sulcus (LS) - Appears as dimpling between 14-16 weeks.

Fig. 2: Showing the surface of brain in GROUP- 2 (>18-24wks).



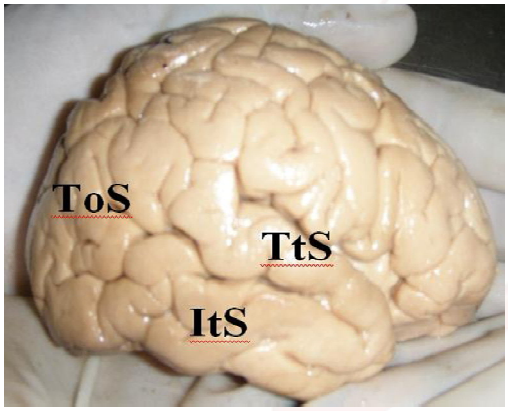
Lateral sulcus becomes more prominent with appearance of insula (I) between 18-20weeks. Central sulcus (CS) – begins parasagittal over the convexity of the supero lateral surface between 18-20 weeks.

Fig. 3: Showing the surface of brain in GROUP-3 (>24-30wks).



Pre central sulcus (PrS) - appears between 24-26 weeks. Superior frontal sulci and superior temporal sulci (StS) – become definite between 24-26weeks. Intraparietal sulcus – is distinguished between 24-26weeks. Post central sulcus (PsS) –appears between 26-28weeks. Inferior frontal sulcus- appear between 26-28weeks.

Fig. 4: Showing the surface of brain in GROUP-4 (>30-36weeks).



Inferior temporal sulcus (ItS), transverse occipital sulcus (ToS), transverse temporal sulcus (TtS) -appears between 30-32weeks.

Fig. 5: Showing the surface of brain in GROUP-5 (>36-40wks):

Appearances of all secondary sulci

DISCUSSION

Brain surface is smooth up to 12-14 weeks and is supported by the findings of Henry Gray [8], but V.I.Savel'eV observed smooth brain at 16weeks [9]. Lateral sulcus in present study appeared initially as a dimple between 14-16weeks and V.I.Savel'eV observed the same at 20th week [9]. Insula is completely formed by 20th week and defines the formation of temporal and frontal lobe and is supported by the findings of T.W.Sadler [10]. Insula appeared as lateral cerebral fossa between 14-16weeks with full formation by 18-20weeks, but A.Afif et al observed insula as sulcus at 13-17weeks with complete formation of lateral sulcus by 30-32weeks [11].In present study we observed principle sulci on frontal, parietal, occipital and temporal lobe by dissection method at 24-30weeks, V.I.Savel'eV observed at 32weeks [9],whereas Catherine Garel et al observed them in MRI between 22-38weeks [12].External appearance of the brain showed remarkable change between 24-28weeks due to increase in the number of sulci, Chi et al observed during 26-28weeks[13] .In present study secondary sulci appeared between 36-38weeks and Chi et al observed between 30-32weeks[13].

Table 2: Comparison of present study with other studies.

Characteristics	Present study	Chi et al, 1977 [13]	Nisikuni,2006 [11]
No of foetuses	50	107	207
Gestational age in weeks	12-40	10-44	12-40
Supero lateral surface (weeks)			
Lateral sulcus	14-16	14	17
Central sulcus	18-20	20	21
Pre central sulcus	24-26	24	26
Superior frontal sulcus	24-26	25	25
Inferior frontal sulcus	26-28	28	30
Post central sulcus	26-28	25	29
Intra parietal sulcus	24-26	26	29
Transverse occipital sulcus	30-32	-	30
Superior temporal sulcus	24-26	23	26
Inferior temporal sulcus	30-32	30	31
Transverse temporal sulcus	30-32	31	33
Secondary sulci	36-38	40	38

CONCLUSION

Brain surface is smooth up to 10-12weeks,later dimple appears for lateral sulcus by 12-14weeks and central sulcus appears by 18-20weeks.The areas around lateral and central sulci become more convoluted during 24-28weeks and areas of frontal, parietal, occipital and temporal become convoluted by during 30-32weeks.All sulci in full term infants are recognised at birth, like that of an adult. After birth, brain

maturation is characterised by more complexity of sulci, so the time of appearance of different sulci is so precise that it appearance is considered to be reliable estimate of foetal age[12]. Abnormal sulcal patterns can be recognized based on the normal appearance. For each gestational age sulcal anomalies are quite specific such as in holo prosencephaly, lissen cephaly, Schizen cephaly and agenesis of the corpus callosum. The brain sulci constitute the fundamental anatomical delimiting landmarks and corridors for modern microsurgery. Because of frequent difficulty in intraoperative localising and visually identifying the brain sulci with assurance. The sulci key points are useful for intraoperative sulcal identification, transsulcal approaches to periventricular and intraventricular lesions.

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Conflicts of Interests: None

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