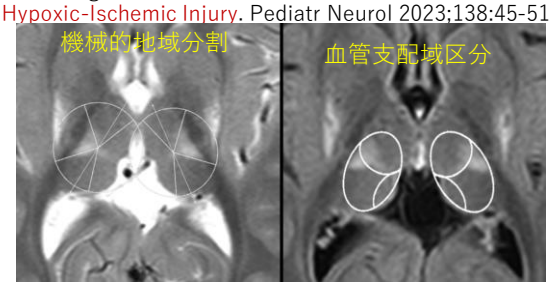
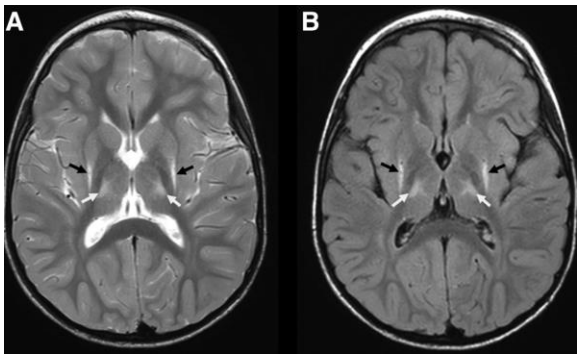
# 発達期脳性運動障害区分の見直し

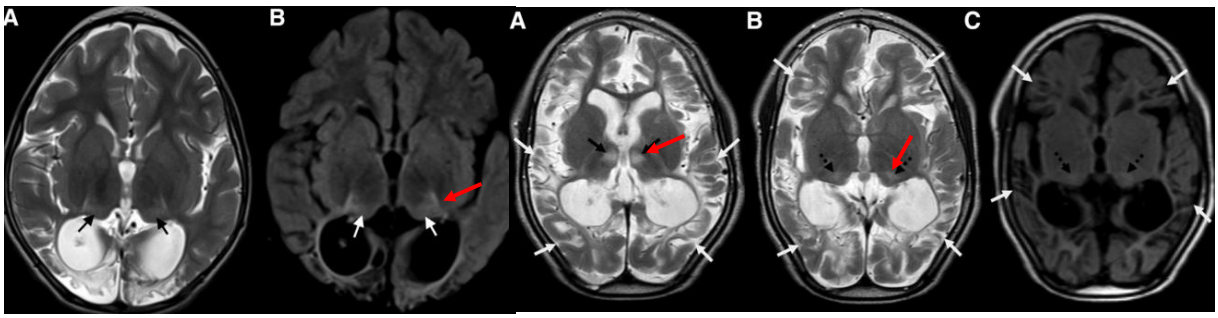

1

## 視床病変区分

Tierradentro-García LO, et al. Distribution of IntraThalamic Injury According to Nuclei and Vascular Territories in Children With Term Hypoxic-Ischemic Injury. Pediatr Neurol 2023;138:45-51.

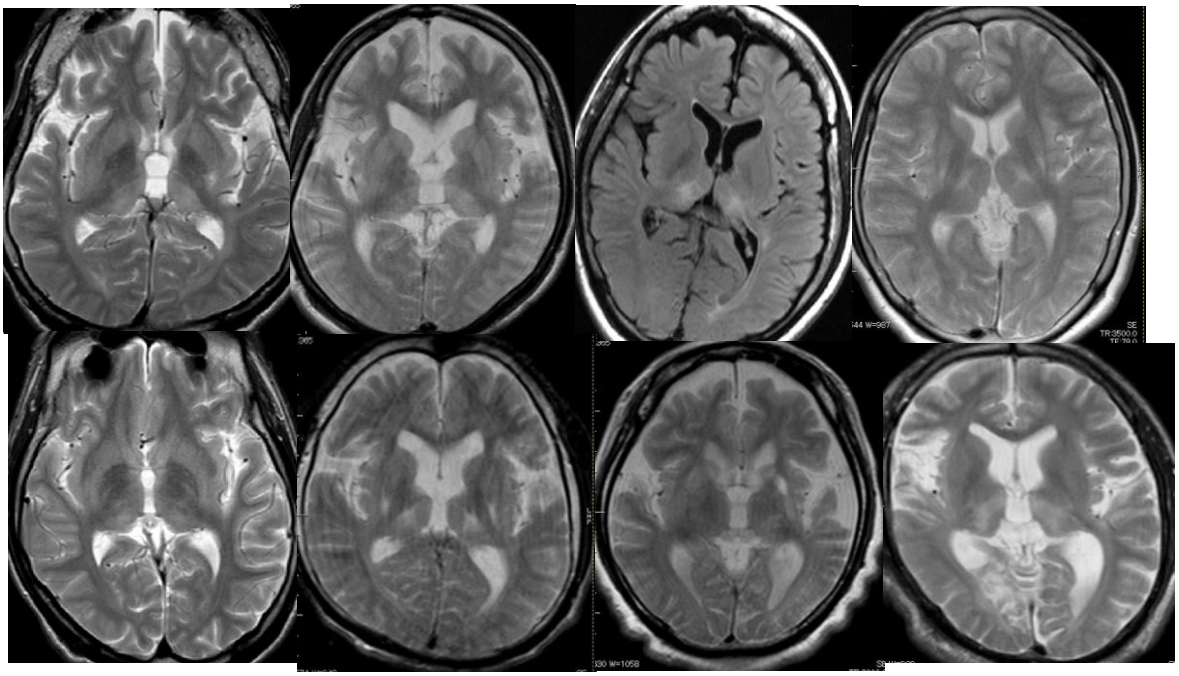


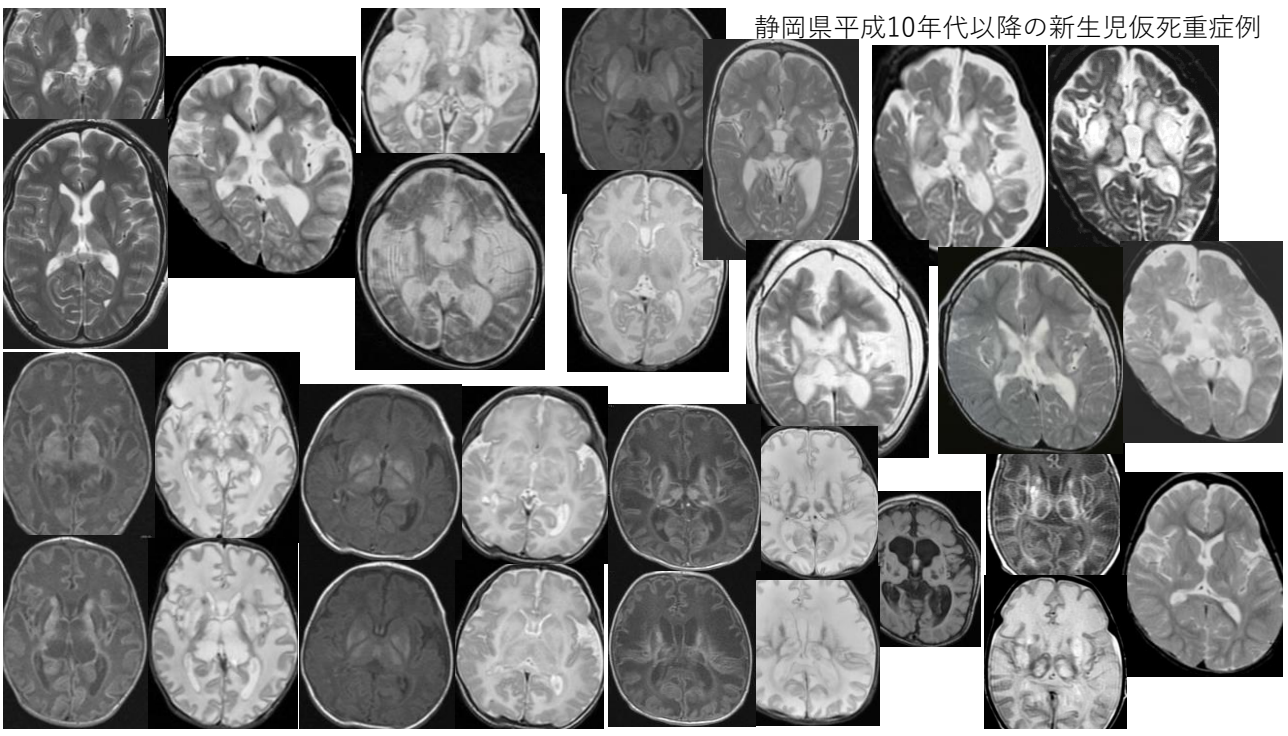

2

愛知県昭和50年代の新生児仮死重症例



3

静岡県平成10年代以降の新生児仮死重症例



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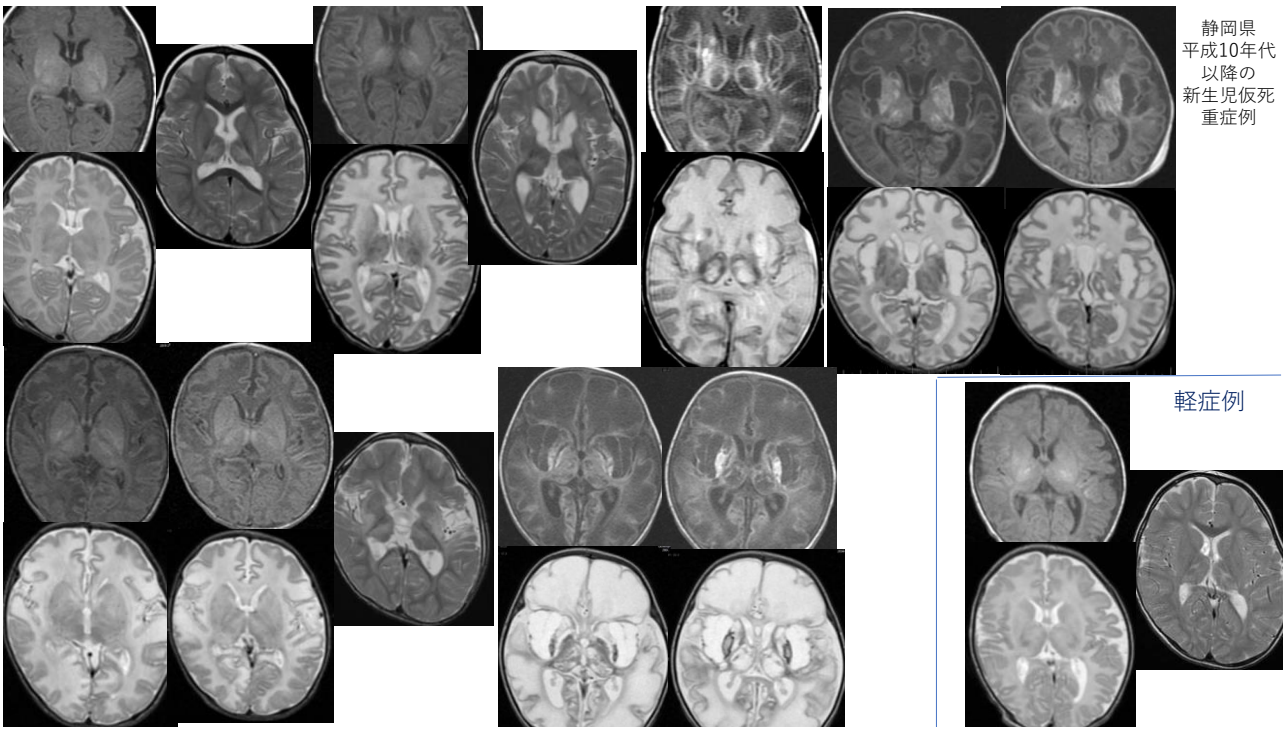


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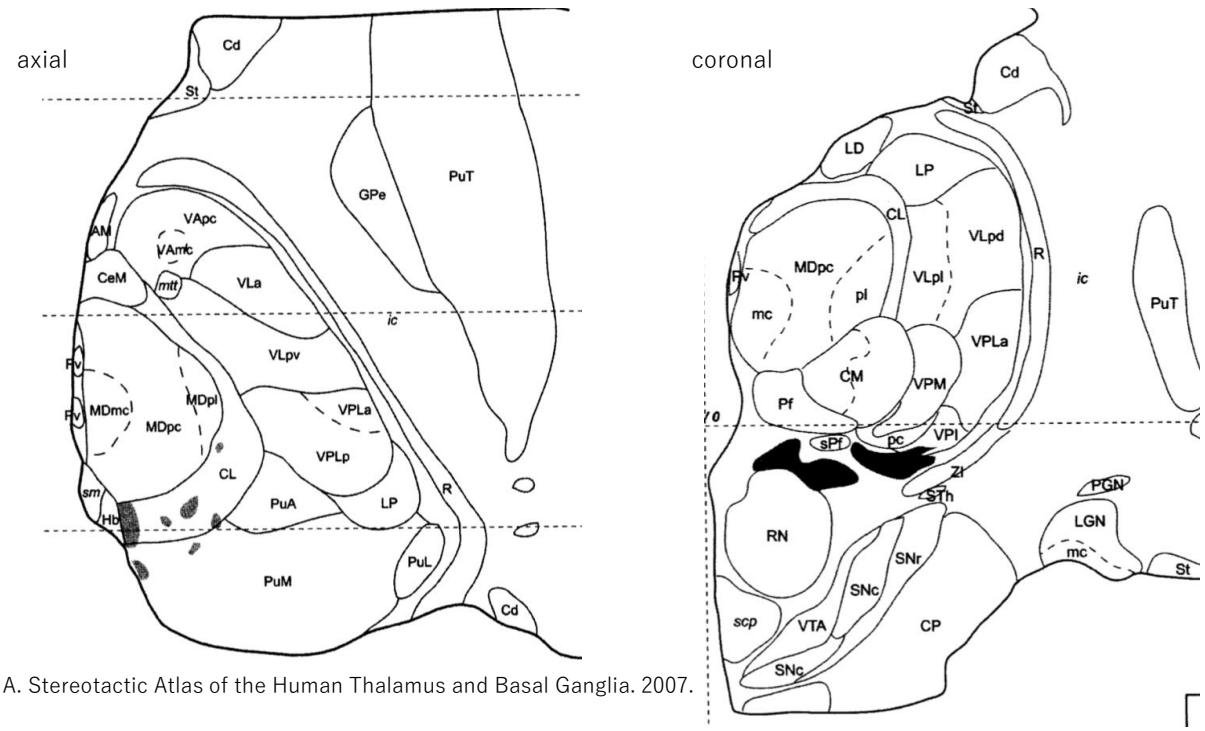
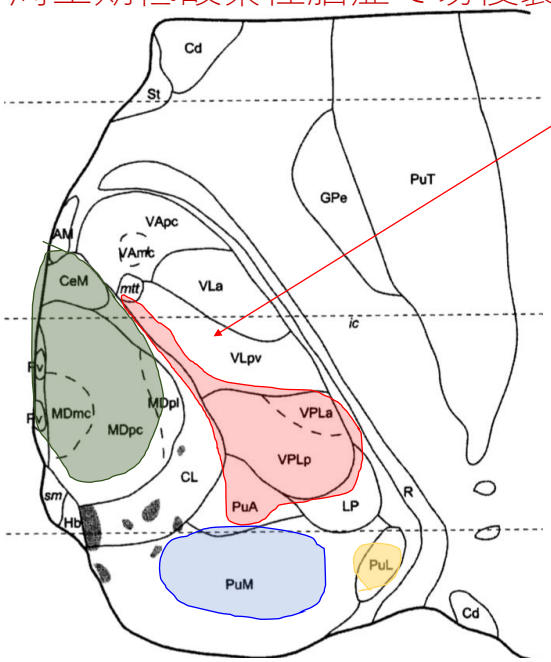



Morel A. Stereotactic Atlas of the Human Thalamus and Basal Ganglia. 2007.

6

# 周生期低酸素性脳症で易侵襲性の４視床部




✓ VL核のこの部に進展しないこともあり

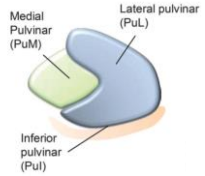
✓ 周生期低酸素性脳症で視床VL核がvulnerableは間違い

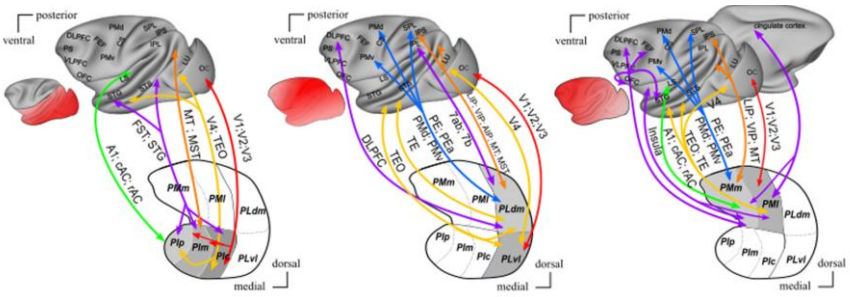
7

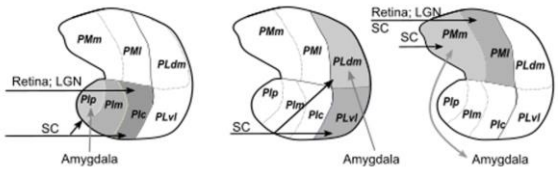
Froesel M et al. A multisensory perspective onto primate pulvinar functions. Neurosci Biobehav Rev 2021;125:231-243.

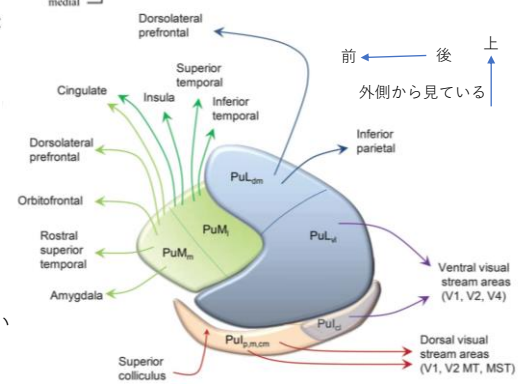
# Pulvinar

Benarroch EE. Pulvinar: associative role in cortical function and clinical correlations. Neurology 2015;84:738-47.



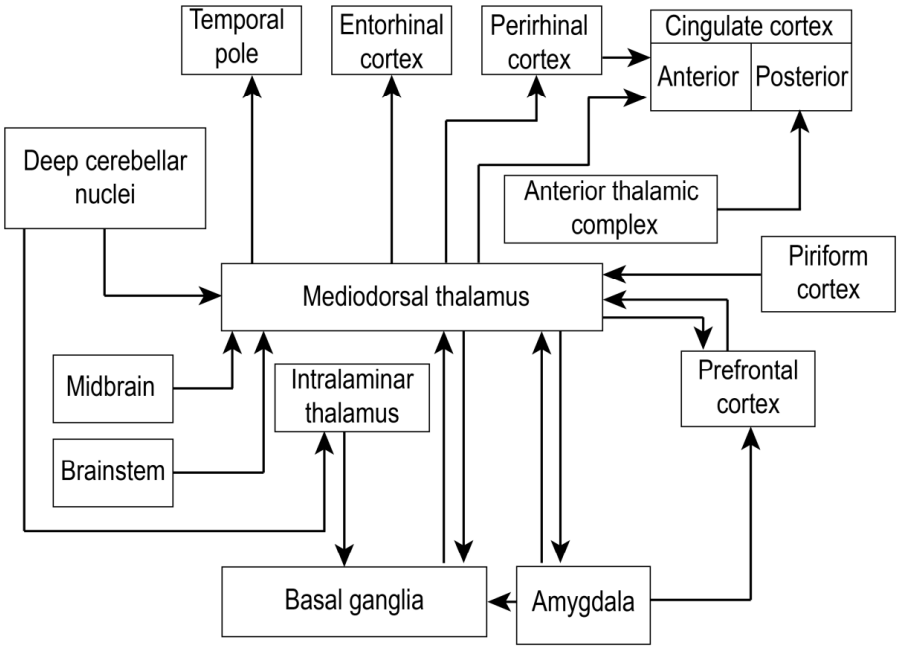




PuAはsomatosensory cortexとconnection　動物では認知されていない

dm:dorsomededial vl:ventrolateral cl:centrolateral cm:centromedial

8

Georgescu IA, et al. The Anatomical and Functional Heterogeneity of the Mediodorsal Thalamus. Brain Sci 2020;10:624.

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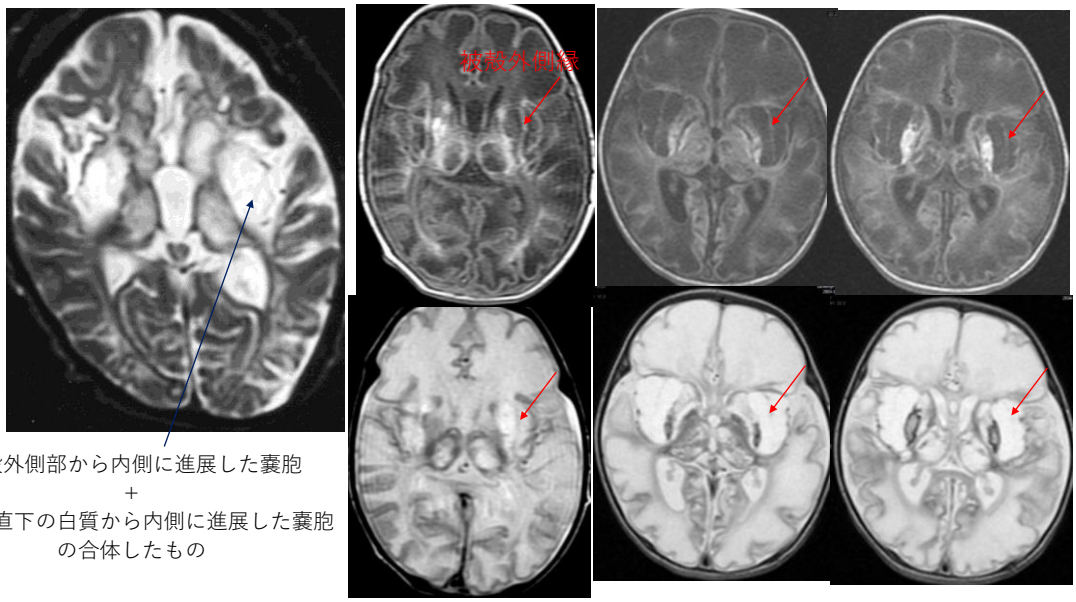


被殻外側部から内側に進展した嚢胞
＋
島皮質直下の白質から内側に進展した嚢胞
の合体したもの

# 周生期低酸素性脳症

## （周生期低酸素性視床基底核大脳皮質白質脳症）

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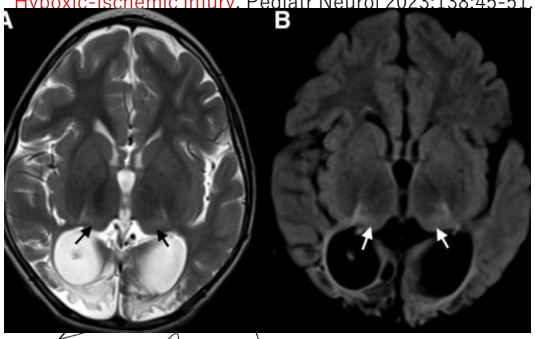
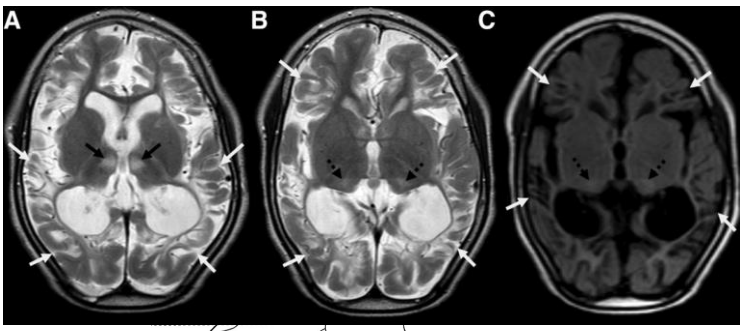
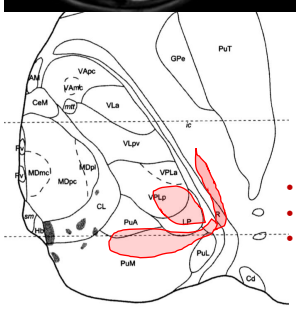
# 周生期脳低血流性障害の視床

Tierradentro-García LO, et al. Distribution of IntraThalamic Injury According to Nuclei and Vascular Territories in Children With Term Hypoxic-Ischemic Injury. Pediatr Neurol 2023;138:45-51.

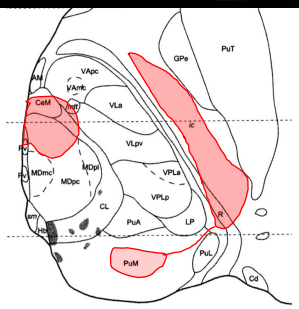


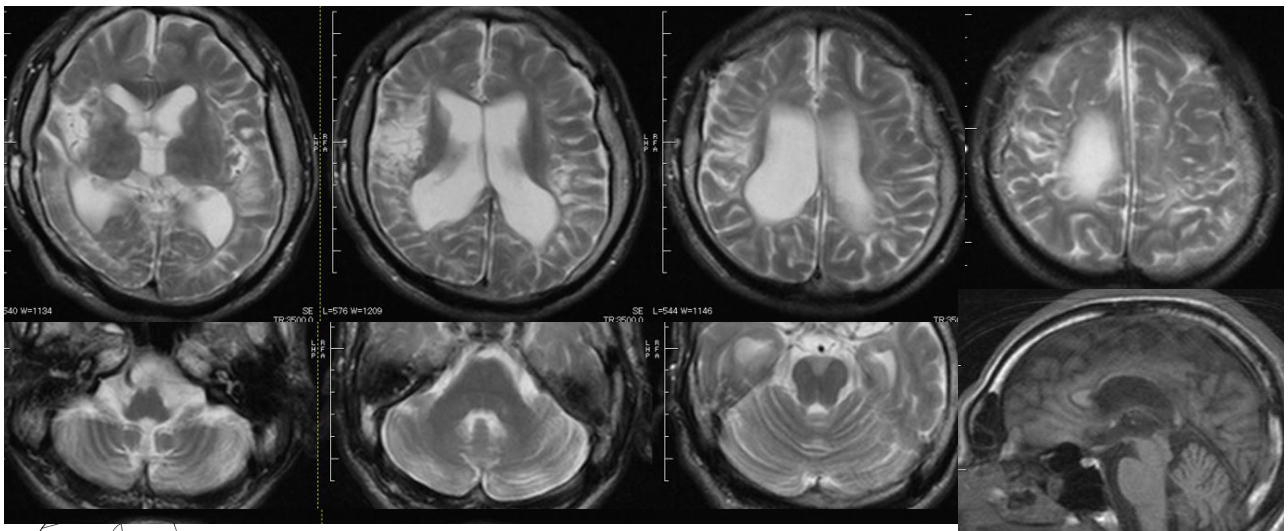

連結する大脳病変の二次的変化

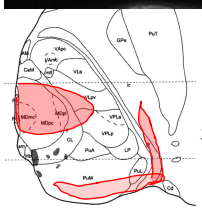
- External medullary lamina
- VPL
- PuM




- CeM-MD
- PuM

11






➢前方型・後方型の区分を越えた脳低血流障害

→全脳型

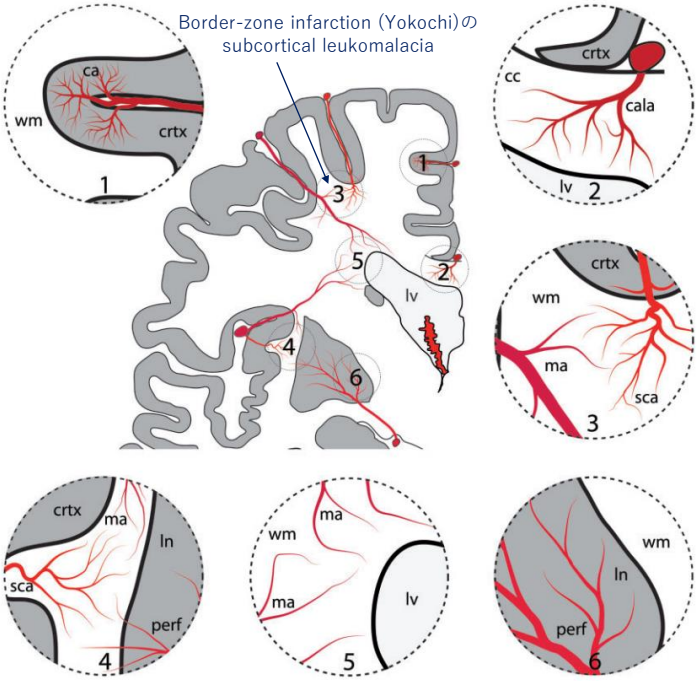
視床･尾状核も二次的病変

*境界域梗塞*の名称は不適

周生期外部型脳低血流障害

12

Smirnov M, et al. Cerebral white matter vasculature: still uncharted? Brain 2021:144;3561–75.




外部型脳低血流障害：Type 1, 3
内部型脳低血流障害：Type 4, 5, 6

**Type 1**: Arterial vascularization of the cortex depends on short arterioles originating from the same pial vessels (single source juxtaposed(並列) supply).
Type 2: The corpus callosum is supplied by short arterioles originating from the pial network (single source juxtaposed supply).
**Type 3**: Short association U-fibers are supplied by subcortical arteries and earliest branches of medullary arteries (dual source interdigitated supply).
**Type 4**: The external capsule, claustrum and extreme capsule take up subcortical arteries, earliest branches of medullary arteries, and terminals of perforating arteries of the base of the brain (triple source interdigitated supply).
**Type 5**: The centrum semiovale is supplied by terminals of deep white matter arteries (single source juxtaposed supply).
**Type 6**: Vessels supplying the basal ganglia and the thalamus are long, perforating arterioles and arteries originating from the base of the brain (single source juxtaposed supply).
cc = corpus callosum; crtx = cortex; ln = lentiform nucleus; lv = lateral ventricle; ma = medullary artery; perf = perforating artery; sca = subcortical artery; wm = white matter.

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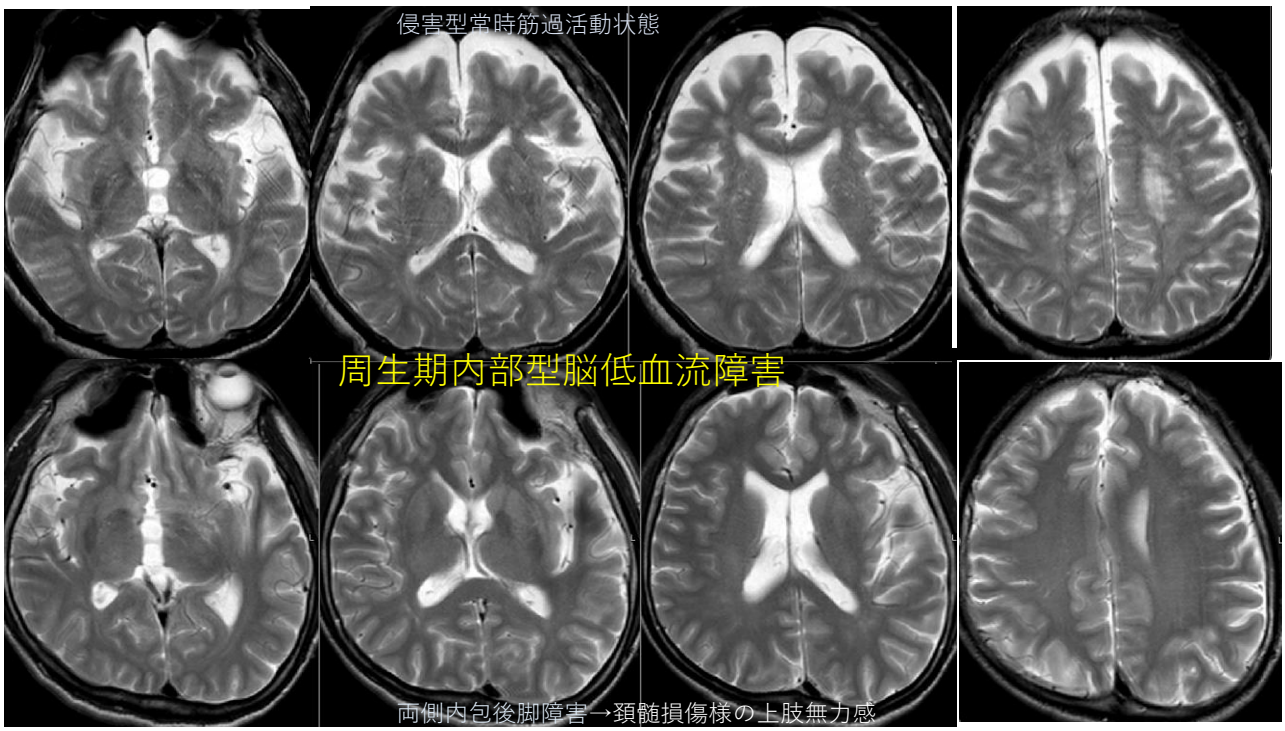


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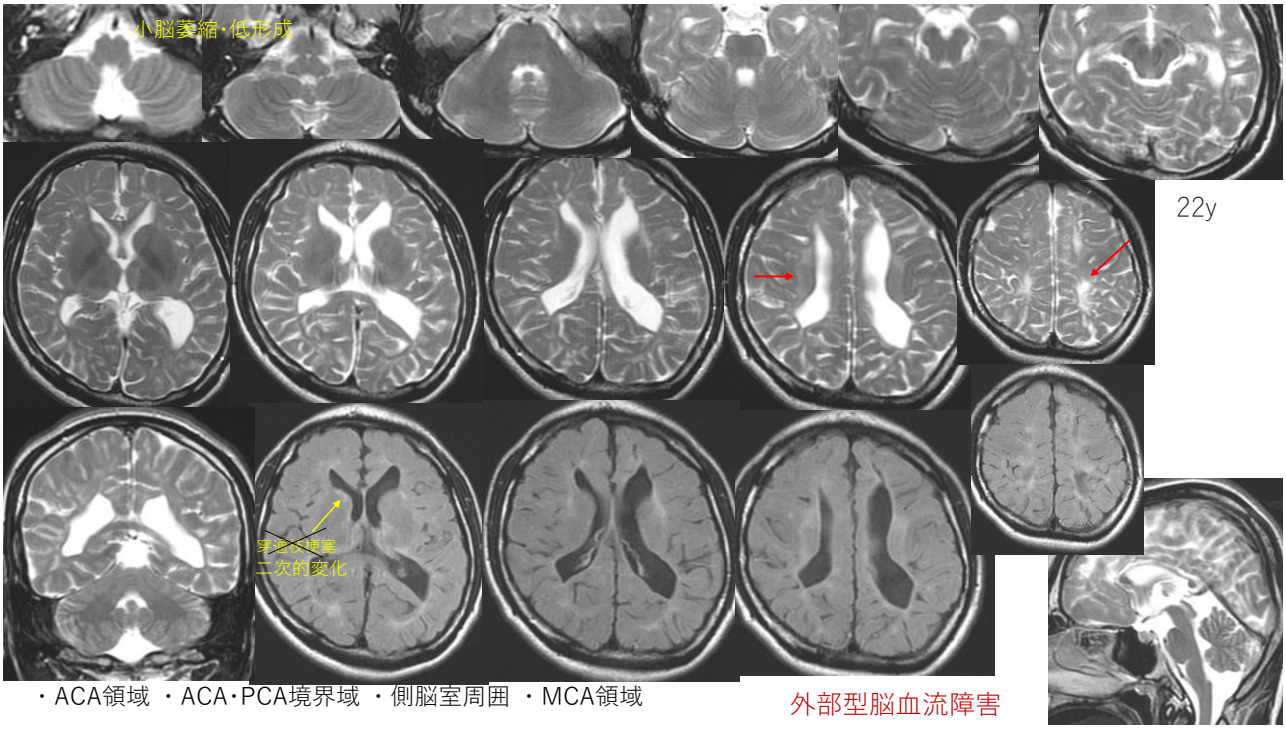


・ACA領域 ・ACA・PCA境界域 ・側脳室周囲 ・MCA領域

外部型脳血流障害

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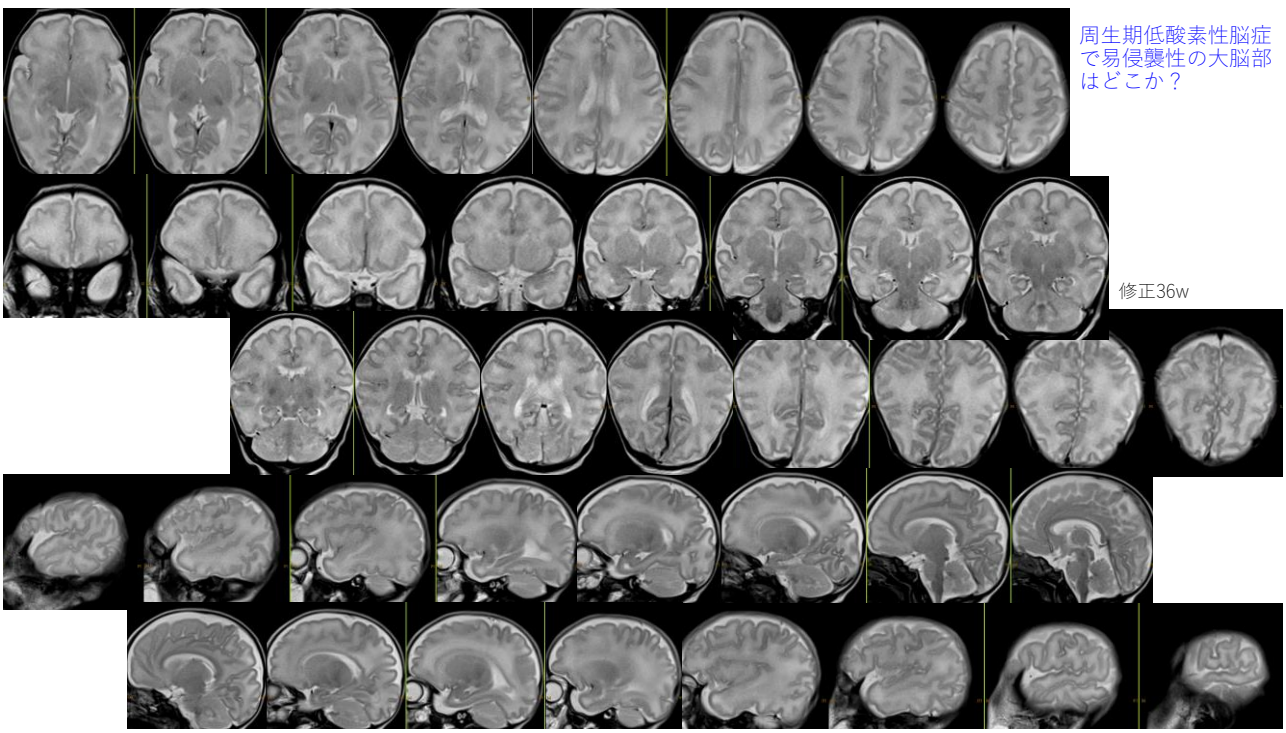


周生期低酸素性脳症で易侵襲性の大脳部はどこか？

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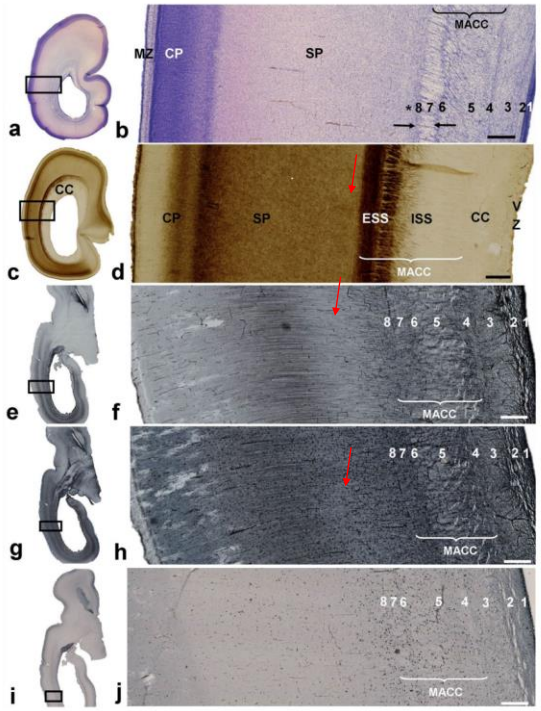



Išasegi IZ, et al. Interactive histogenesis of axonal strata and proliferative zones in the human fetal cerebral wall. Brain Struct Funct 2018;223:3919-3943.

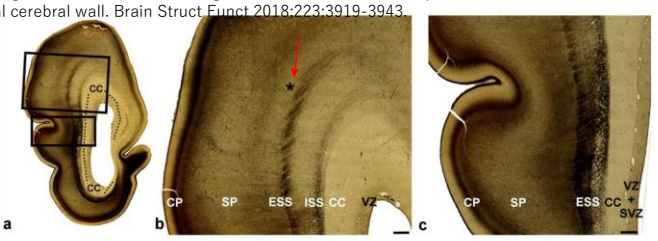
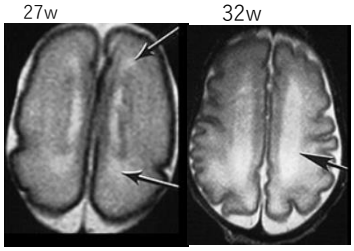



**Fig. 7** Coronal section through the parietooccipital part of a brain at 26 PCW and stained for AChE showing pulvinocortical and basal forebrain fibers of axonal sagittal strata as AChE-reactive. Callosal (CC) and associative (**b** asterisk) fibers, and primary optic radiation are AChE-unreactive. CC is characterized by continuity around ventricles (**a** dots). Rectangles in **a** are displayed at higher magnification in **b, c**. (*VZ* ventricular zone, *SVZ* subventricular zone, *ISS* internal sagittal stratum, *ESS* external sagittal stratum, *SP* subplate, *CP* cortical plate). Scale bar = 1 mm

◂**Fig. 8** Laminar organization of the sagittal strata during the early preterm period. Coronal Nissl-stained frozen section (**a, b**) through the parietooccipital portion of the brain at 26 PCW showing a similar laminar organization as seen in the previous phases (see Fig. 5). The internal sagittal stratum (ISS) is densely cellular (**b** number 5), and this stratum may be partially defined on both AChE-stained and unstained portion (**d**) on section of the brain at the same age. At this age, both cellular (O)SVZ and former fibrillar intermediate zone now are incorporated in multilaminar axonal-cellular compartment (MACC). Rectangles in **a, c, e, g**, and **i** are shown at higher magnifications in **b, d, f, h**, and **j**, respectively. Sublamination of the sagittal fiber strata and related cell layers were also visible on horizontal histological sections of brain at 24.5 PCW when immunostained for vimentin (**e, f**), GFAP (**g, h**), and Ki67 (**i, j**). Numbers (1–8) used to mark the laminas are explained in detail in Fig. 5. Immunostaining for glial markers (**e**–**h**) showed that the radial glia transverses the radial–sagittal strata and subplate (SP) to reach the cortical plate (CP). Immunostaining for proliferative markers (**i, j**) showed proliferative activity in cellular–fibrillar layers, except in the compact periventricular (callosal) system. The two proliferative cell layers (**b** between arrows) were not a constant finding on Nissl-stained preparations of the occipital lobe (see Fig. 5). Asterisk (**b**) represents prospective associative fibers. Radial striations were visible both on Nissl and AChE preparations due to the intersection of radially oriented cell strands and sagittally running fibers (*VZ* ventricular zone, *CC* corpus callosum, *MZ* marginal zone). Scale bar = 500 μm

27w 32w



- 上記T2高信号はどこにあたり、組織学実体は何？
- Crossroadsはこの一部か全体か？
- ESS直近外側部（↓）が最も侵されやすいか

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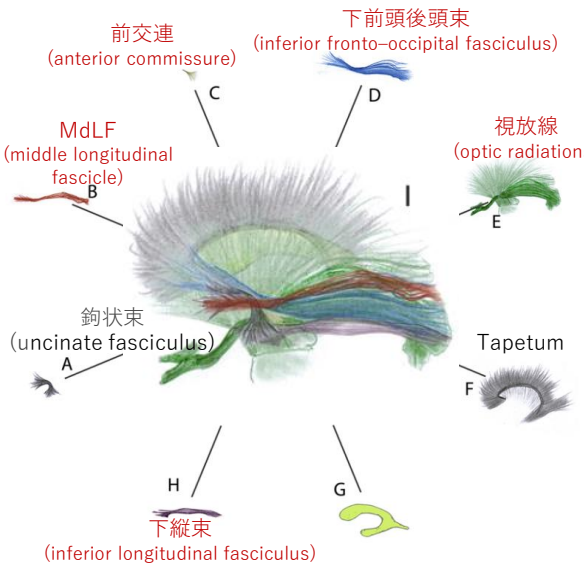
# Sagittal stratum (SS)




Heinrich Sachs (1892) 三角部･後角周囲白質を命名
stratum sagittale internumとexternumに二分

➢ SSは、外側は上縦束(superior longitudinal fasciculus)･弓状束(arcuate fasciculus)複合で、内側はtapetumにある全白質を指す。概ね水平方向の線維走行である

- 鉤状束がSSの前縁となる
- MdLFはSS外側層の背側部をなす
- 前交連の線維束は、下前頭後頭束と弓状束と被われる
- 下前頭後頭束の後方部はSSに合体し、三角部･後角の主な線維束となる。さらに後方では、視放線に入る
- SS内側層は視放線を含む。Thalamic posterior radiationsと同一面にあり。Tapetumを被う

➢ SSはB-EとHの平面

- 前縁は弓状束で、腹側縁は下縦束である。背側･後側は同定できない

Maldonado IL, et al. Composition and organization of the sagittal stratum in the human brain: a fiber dissection study. J Neurosurg 2021;135:1214-22.

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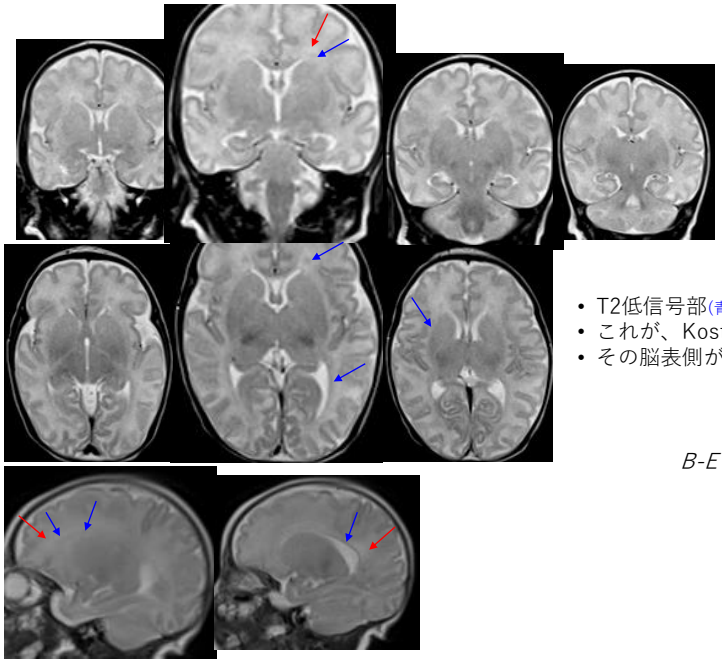
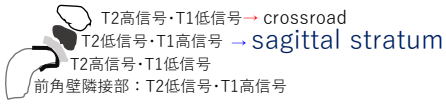
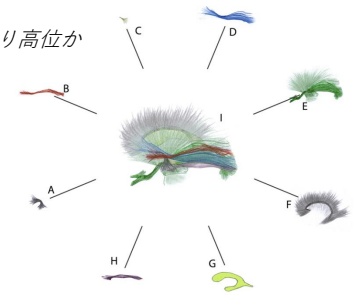





- T2低信号部(青矢印)は、満期で髄鞘化部として同定できる実体である
- これが、Kostovicのsagittal stratumであろう
- その脳表側がcrossroadsであり、早産白質障害の易嚢胞部であろう

*B-EとHの平面より高位か*

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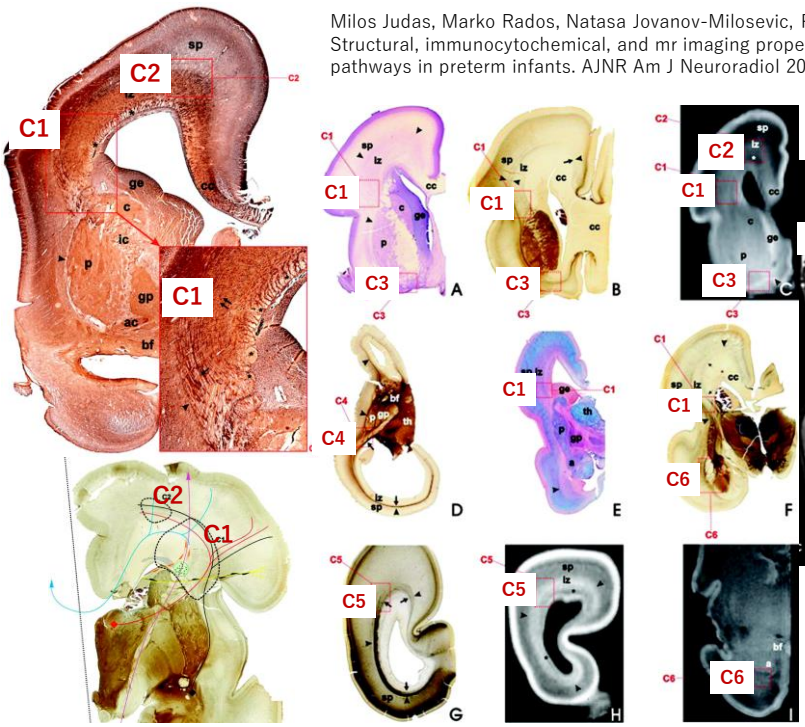
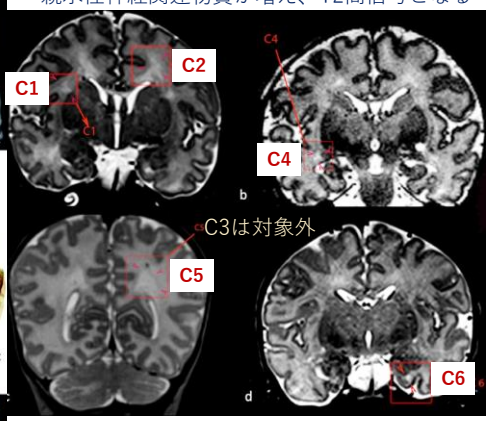
Milos Judas, Marko Rados, Natasa Jovanov-Milosevic, Pero Hrabac, Ranka Stern-Padovan, Ivica Kostovic. Structural, immunocytochemical, and mr imaging properties of periventricular crossroads of growing cortical pathways in preterm infants. AJNR Am J Neuroradiol 2005;26:2671-84.




## Periventricular crossroad areas

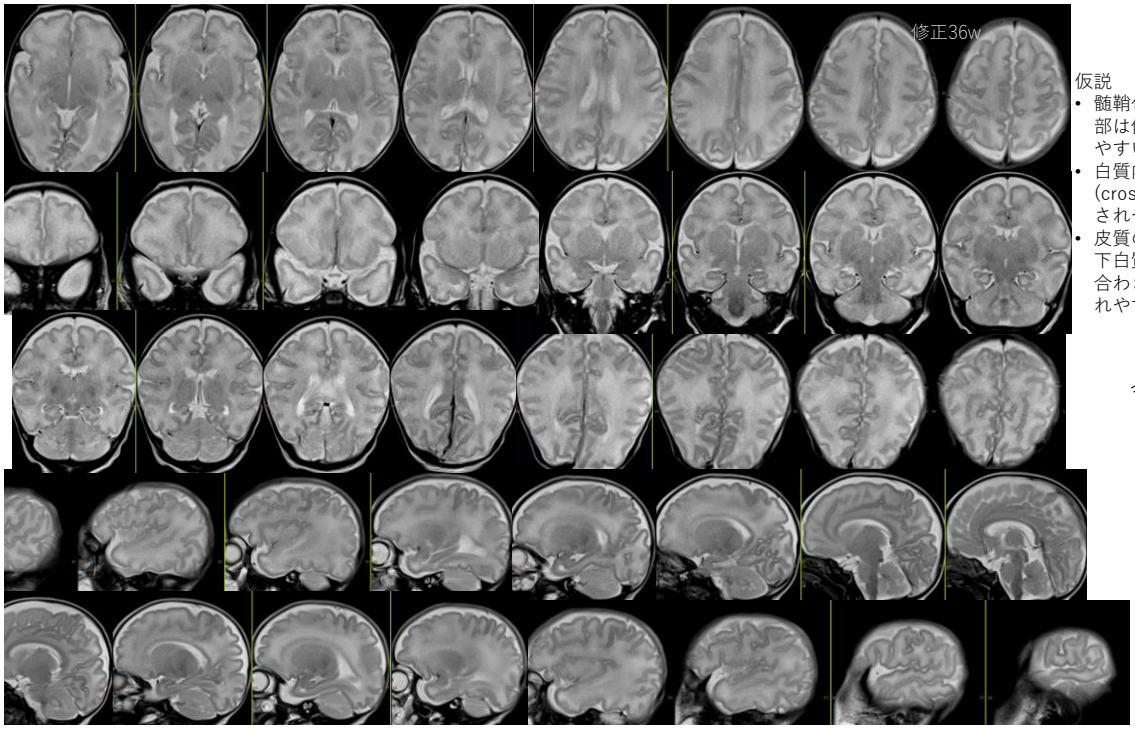
親水性神経関連物質が増え、T2高信号となる




Pittet MP et al. Newborns and preterm infants at term equivalent age: A semi-quantitative assessment of cerebral maturity. Neuroimage Clin 2019;24:102014.

*C1-C6に限る理はあるか*

20




仮説
- 髄鞘化が進んでいる部は低酸素に侵されやすい
- 白質内のT2高信号部(crossroads相当)は侵されやすい
- 皮質の低信号化と直下白質高信号の組み合わさった部は侵されやすい

*次回検討*

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