

CLINICAL APPLICATIONS USING MRI SPIN- LABELING TO MONITOR CSF MOVEMENT

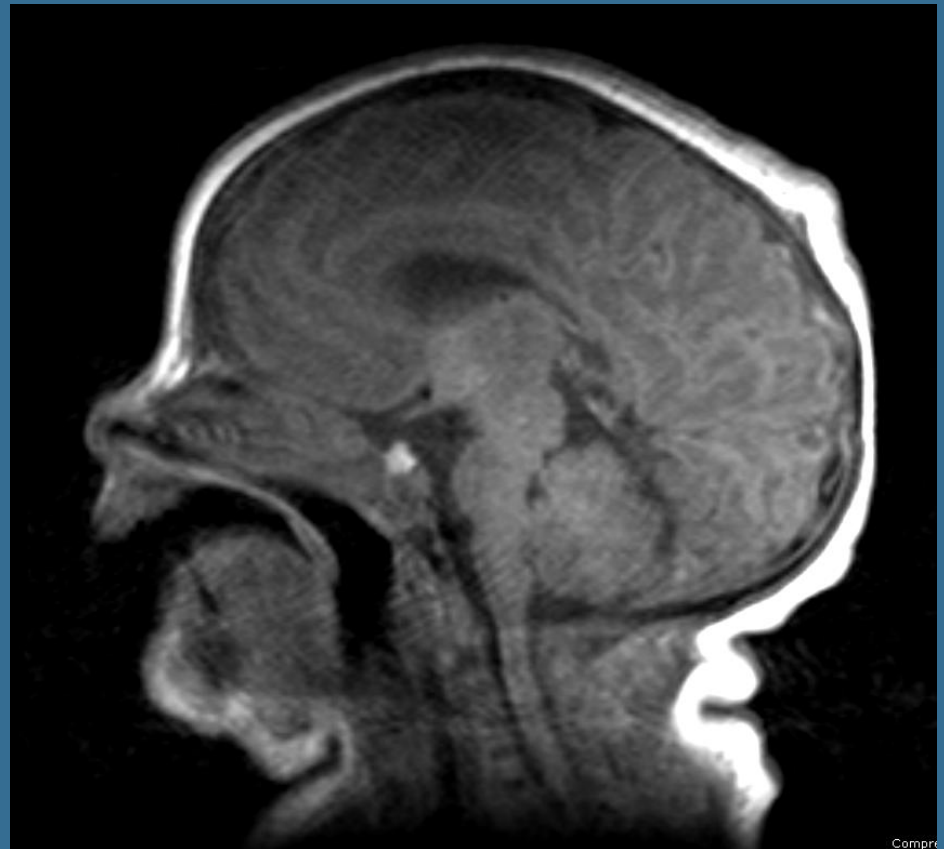
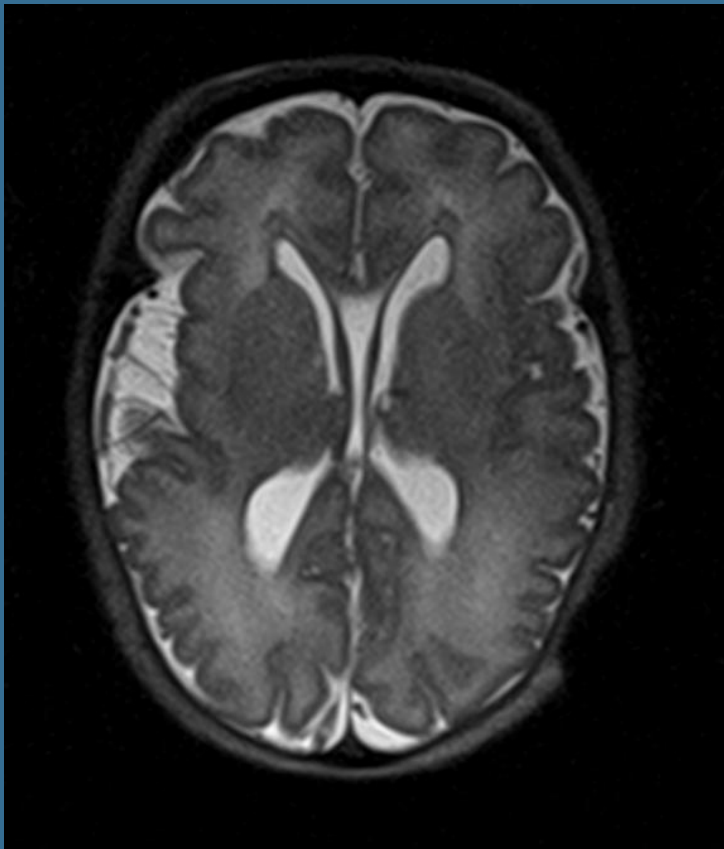
**J. Gordon McComb MD, Matt Borzage PhD, &
Stefan Bluml PhD**

Division of Neurosurgery and Department of Radiology,
Children's Hospital Los Angeles, Keck School of Medicine,
University of Southern California

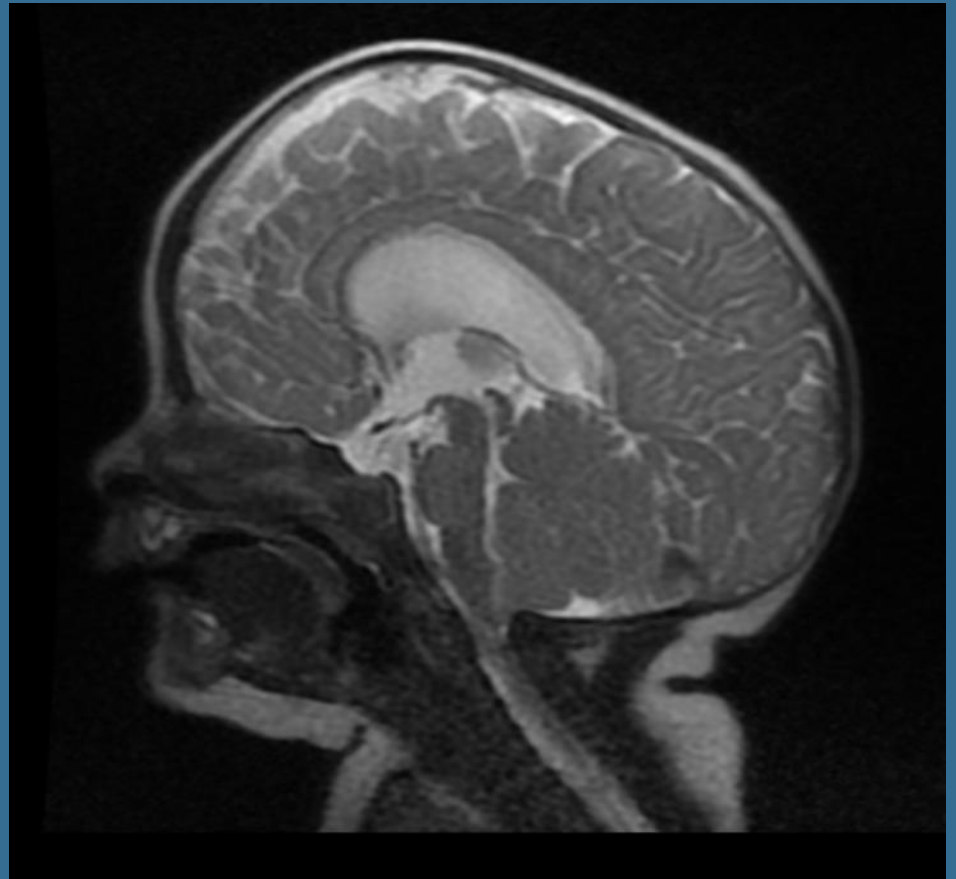
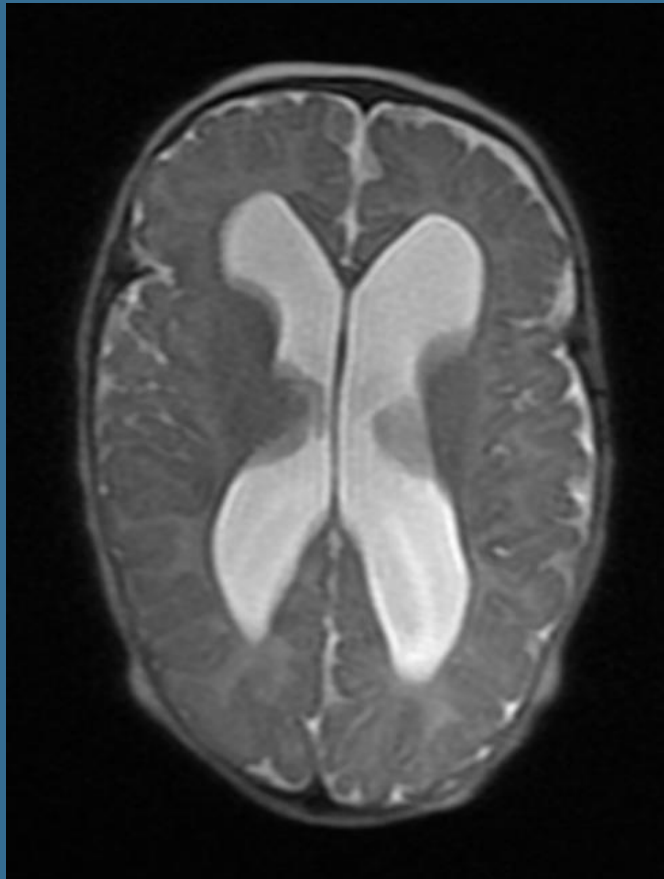


Use of Time-SLIP in a Pediatric Population

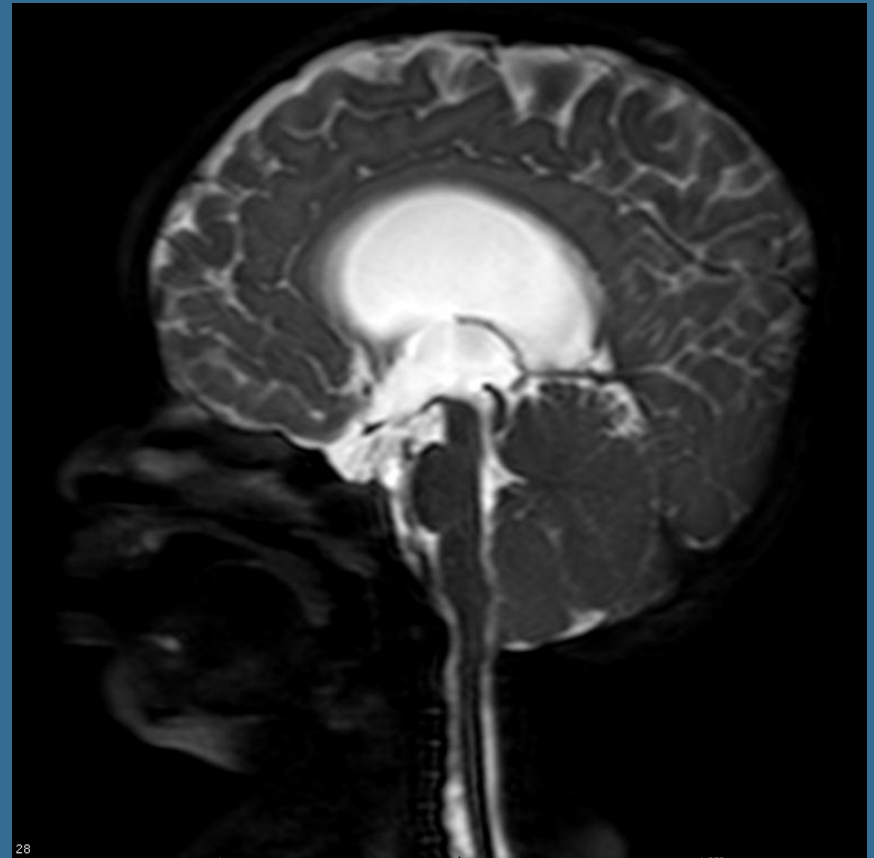
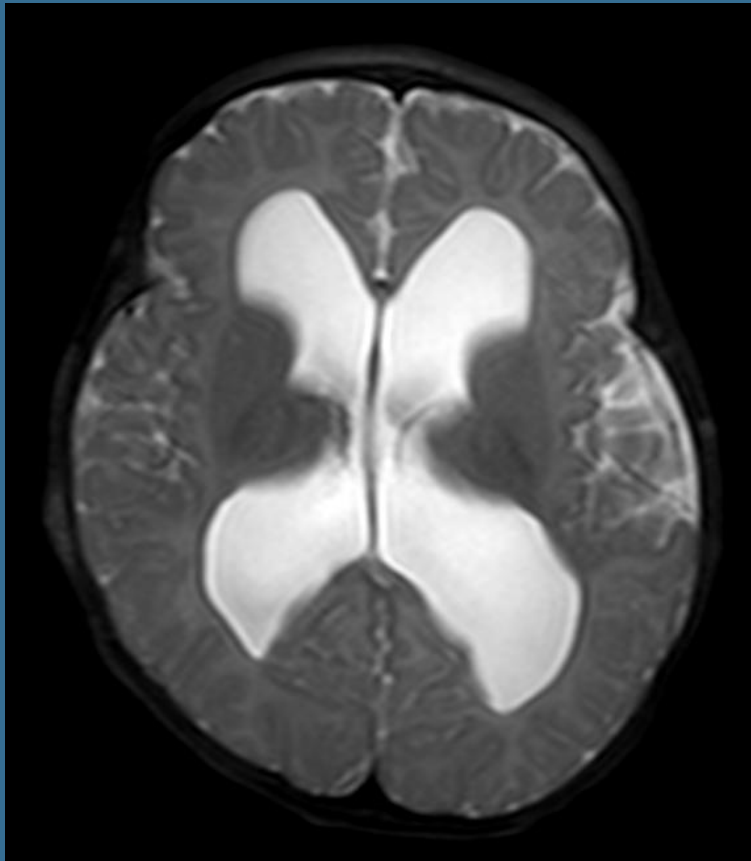
Sagittal synostosis: 5 days of age



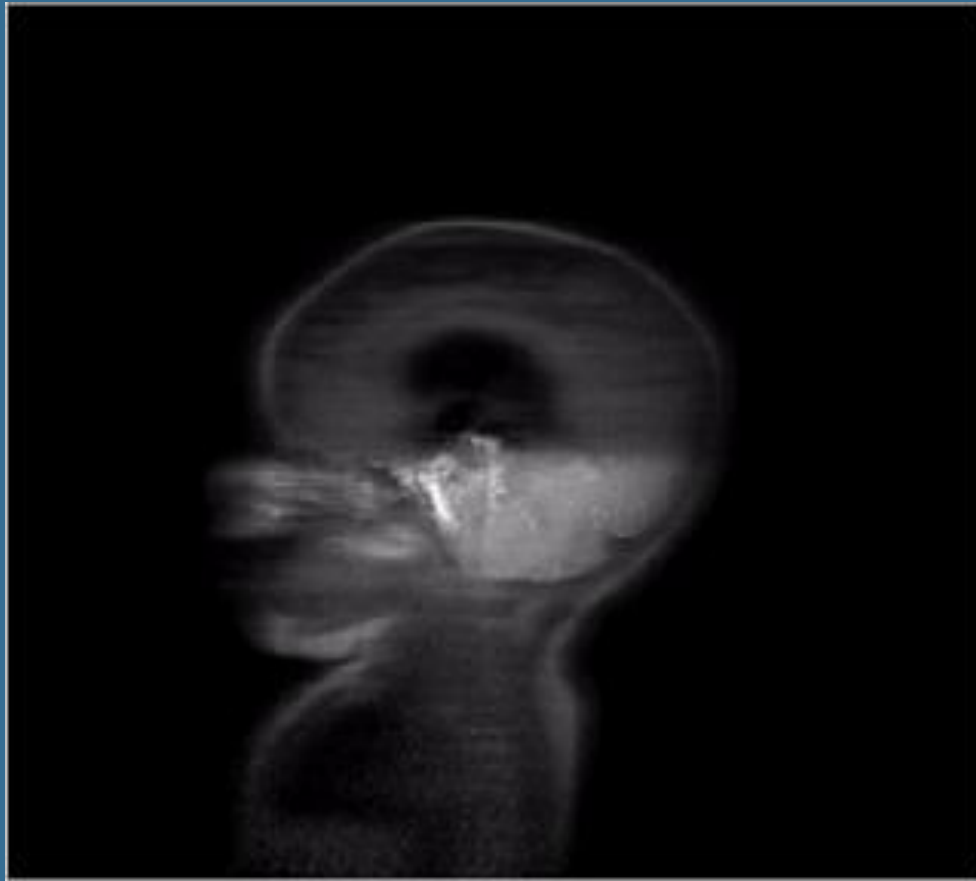
Sagittal synostosis: 3 mo old, preop



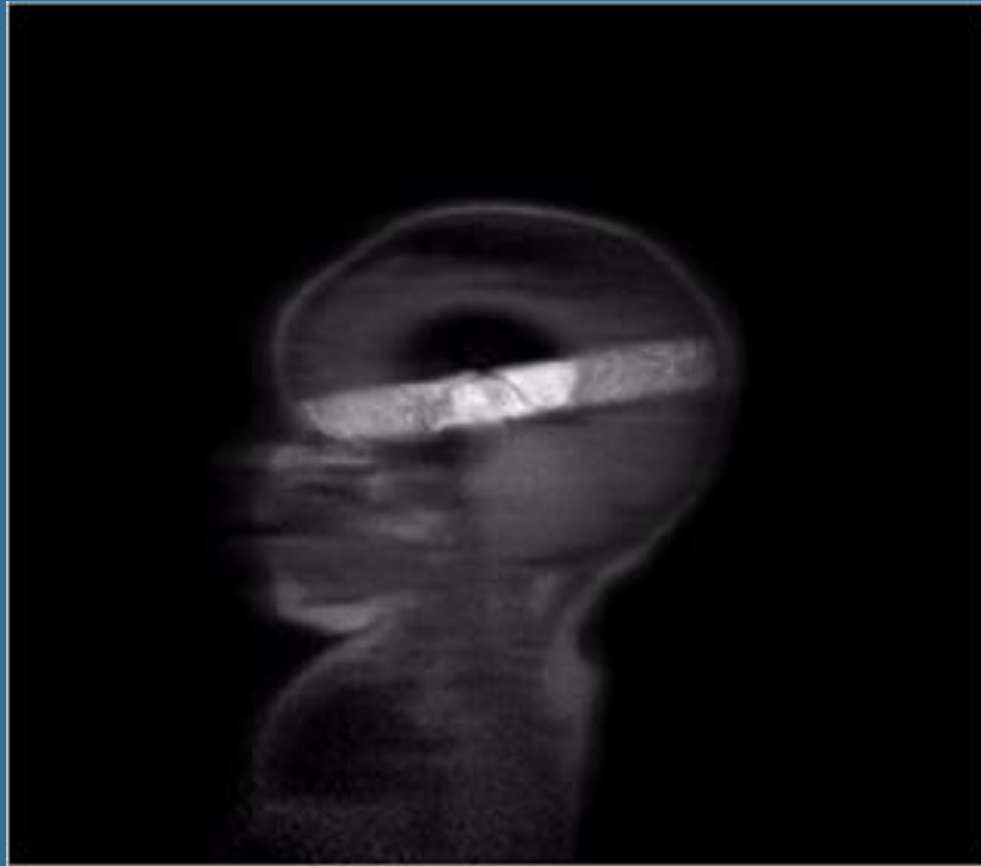
Sagittal synostosis: 5 mo old, 1 mo postop



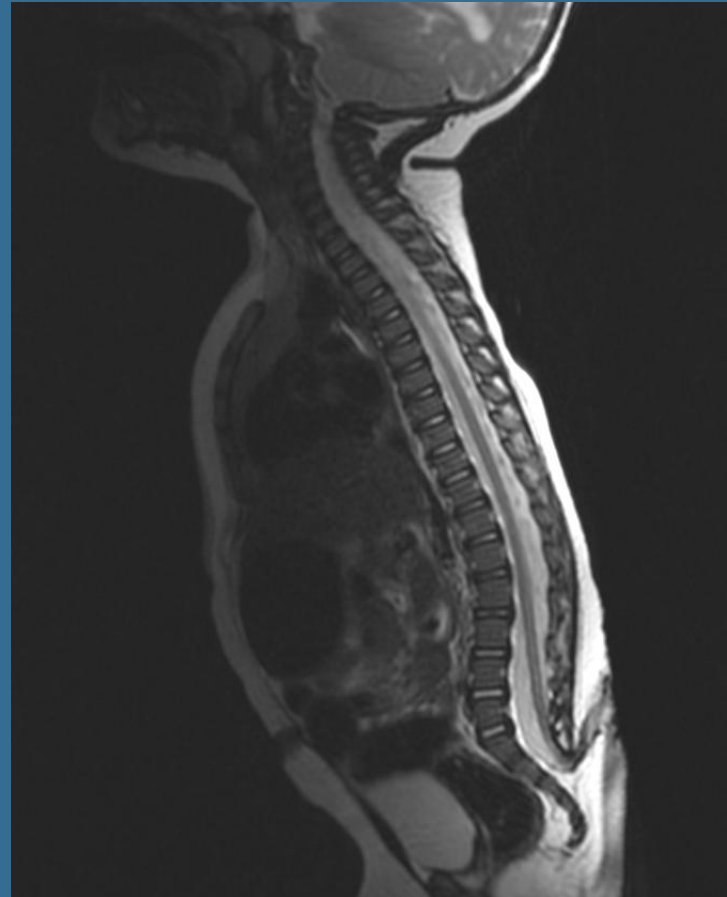
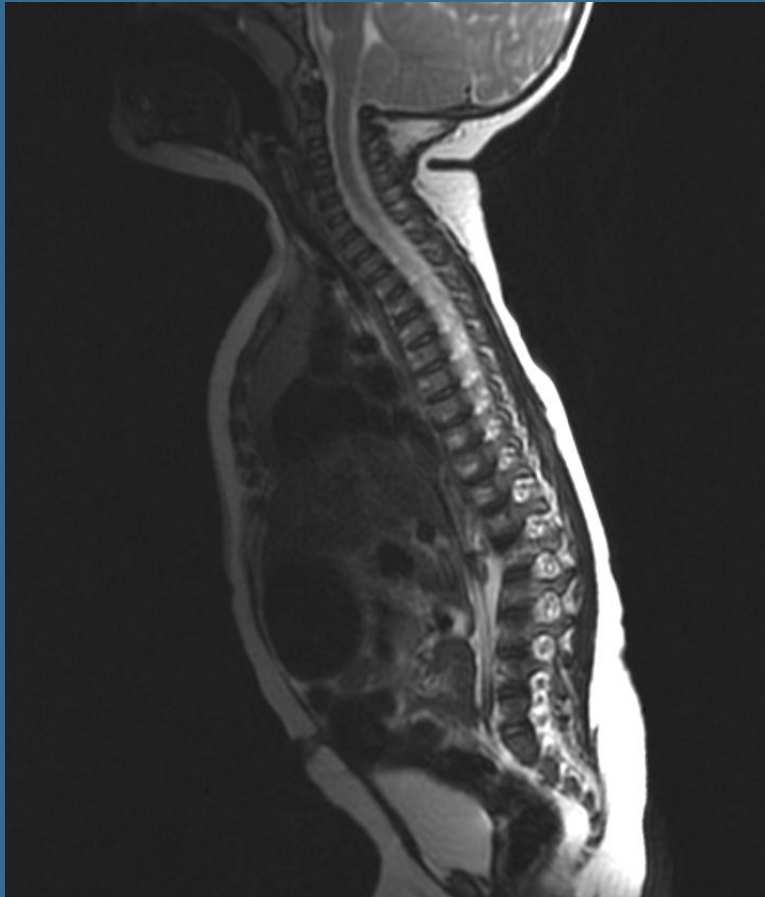
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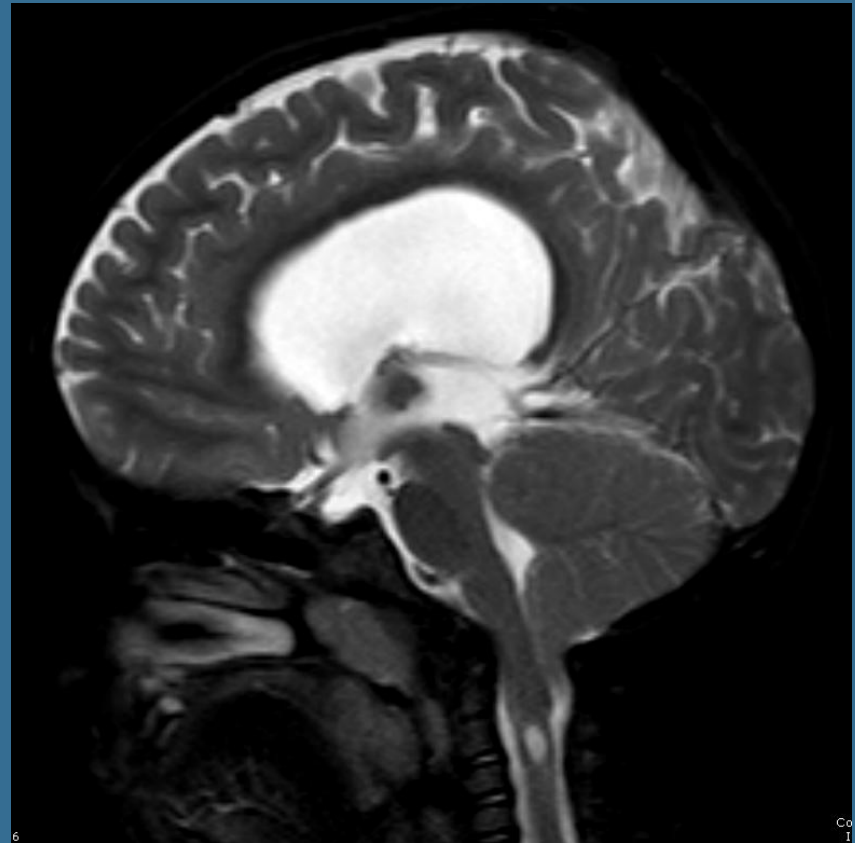
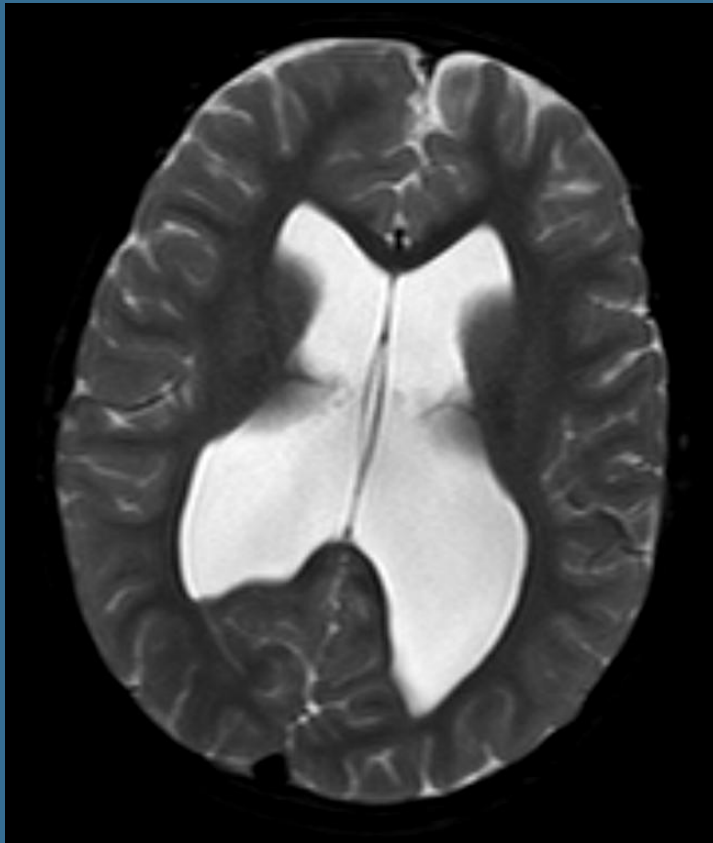
Closed NTD: 7 mo, pre repair



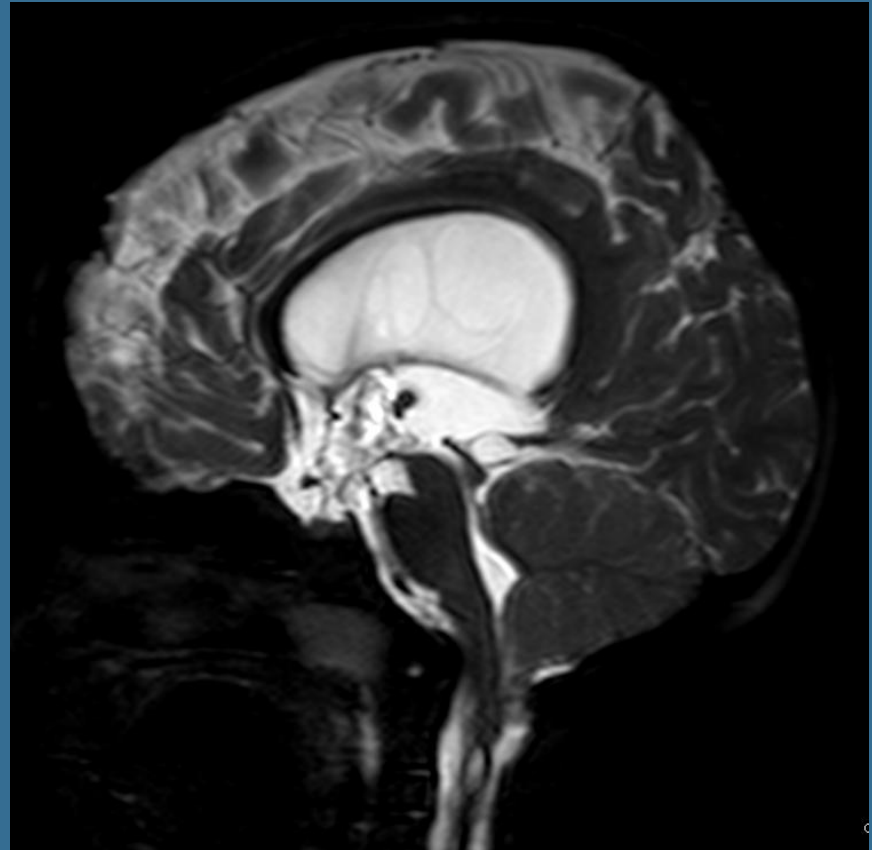
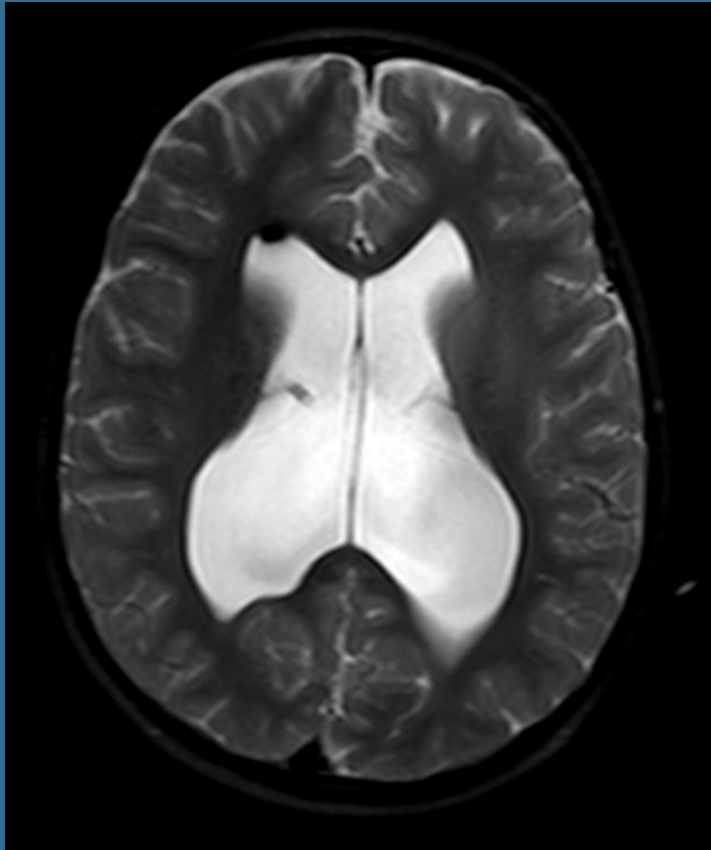
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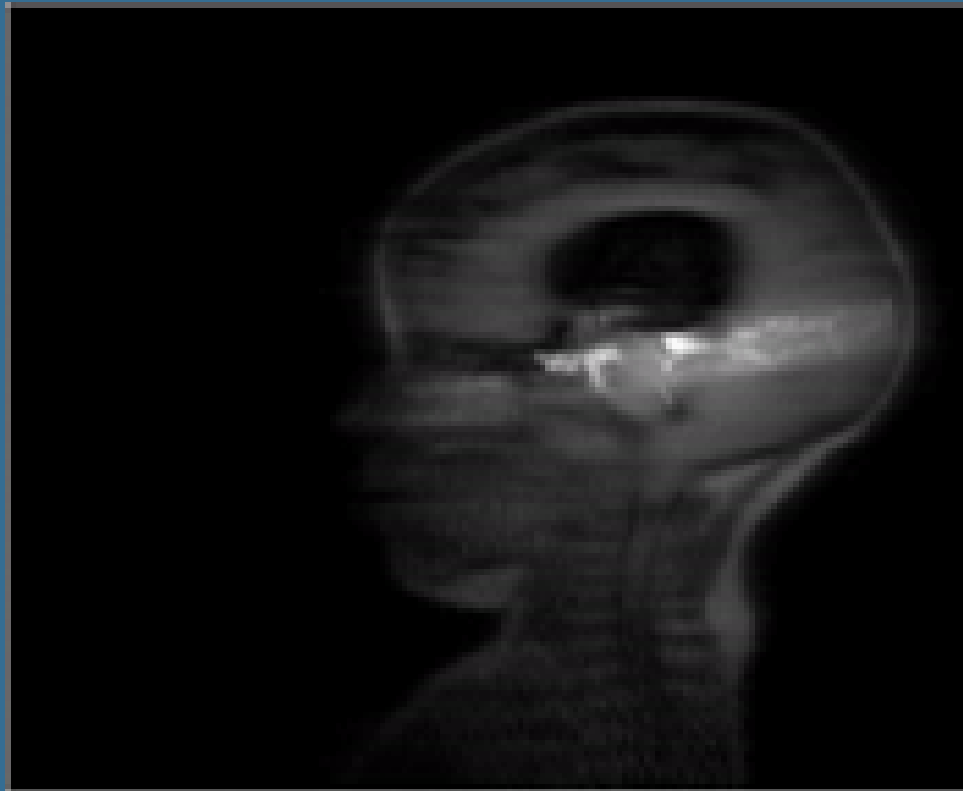
Hydrocephalus, Chiari I, Syrinx: 4 yr 5 mo, pre ETV



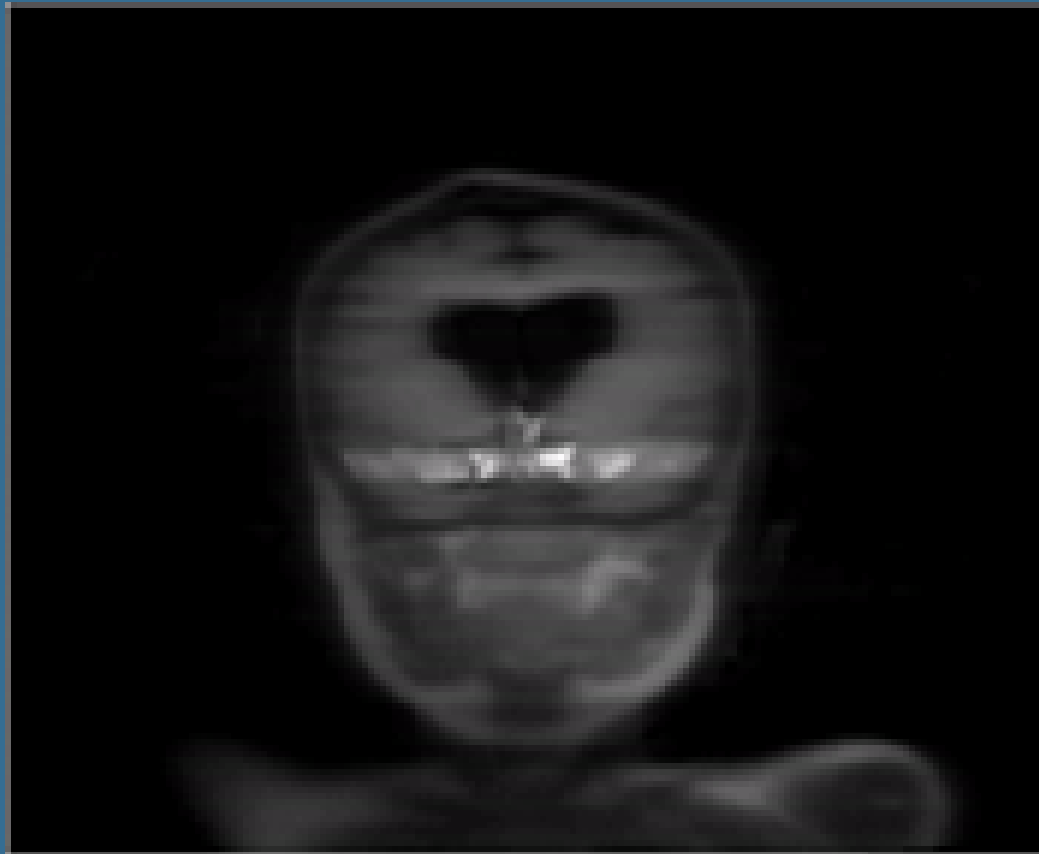
Hydrocephalus, Chiari I, Syrinx: 4 yr 6 mo, 3 d post ETV



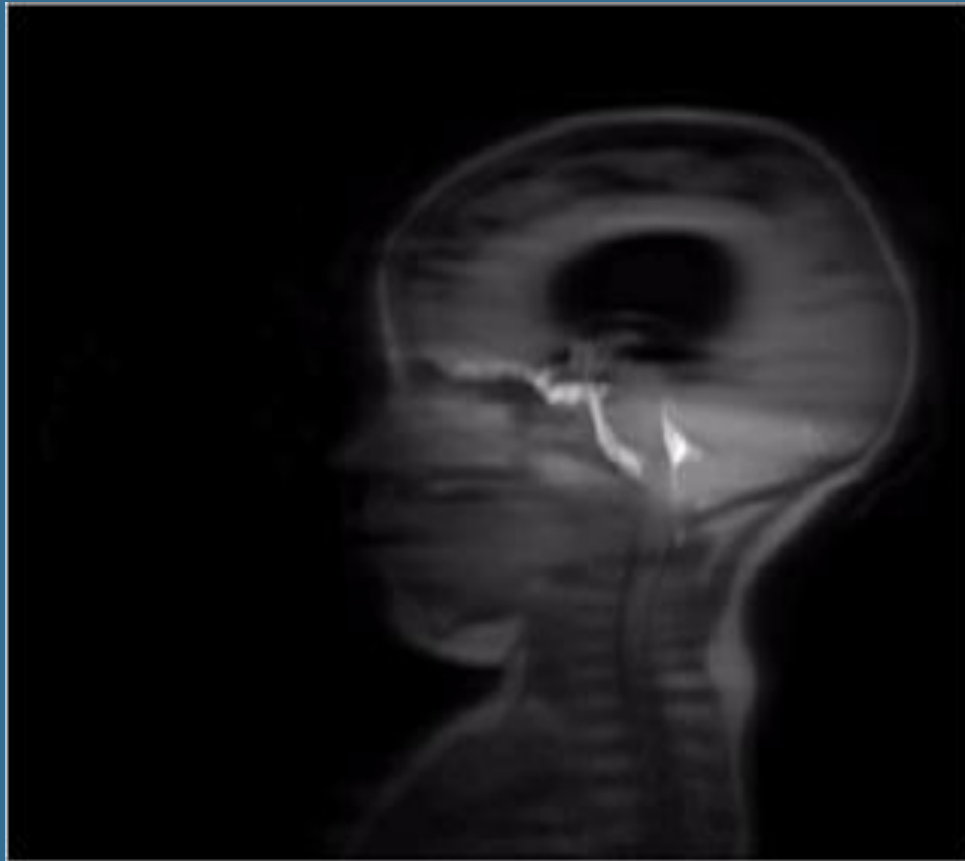
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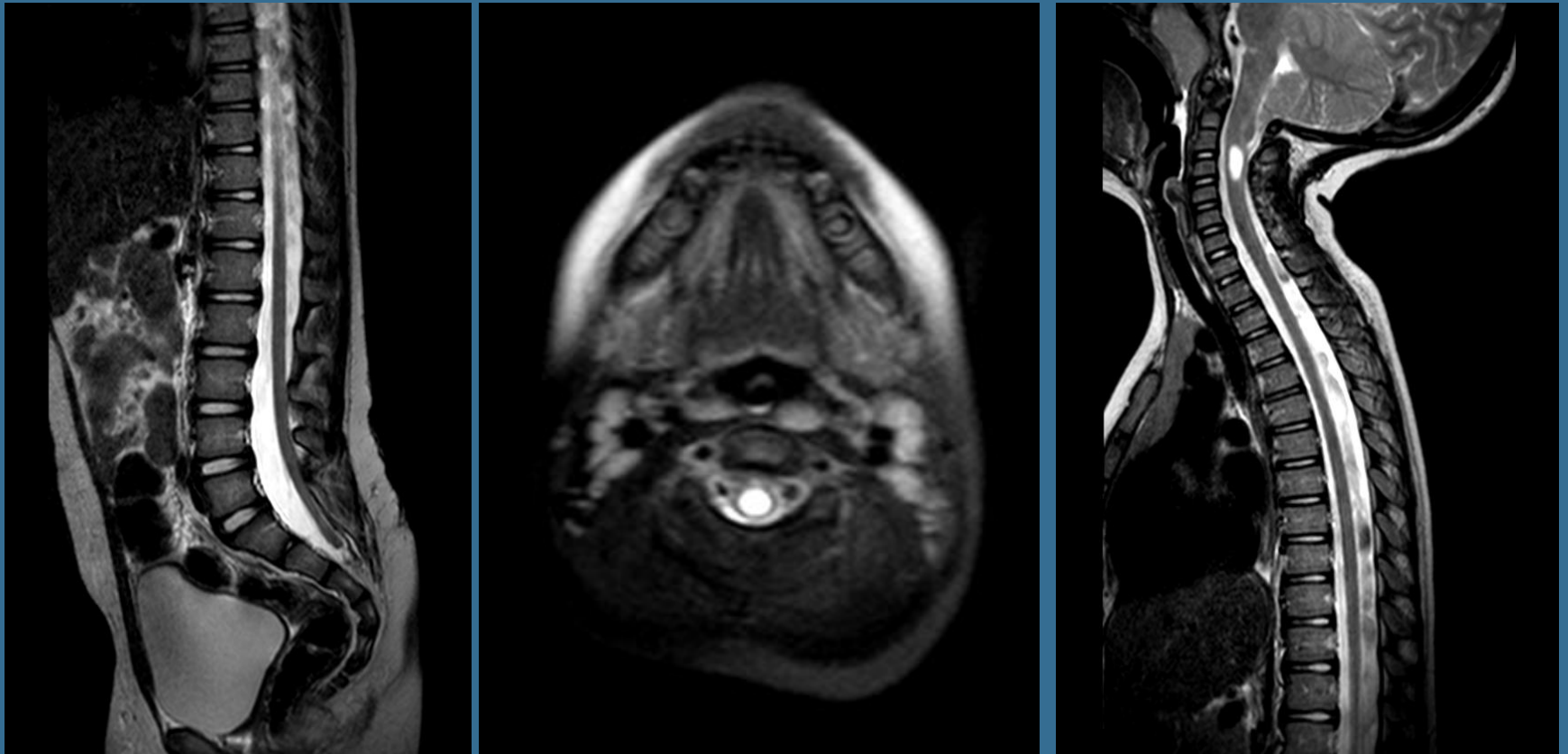
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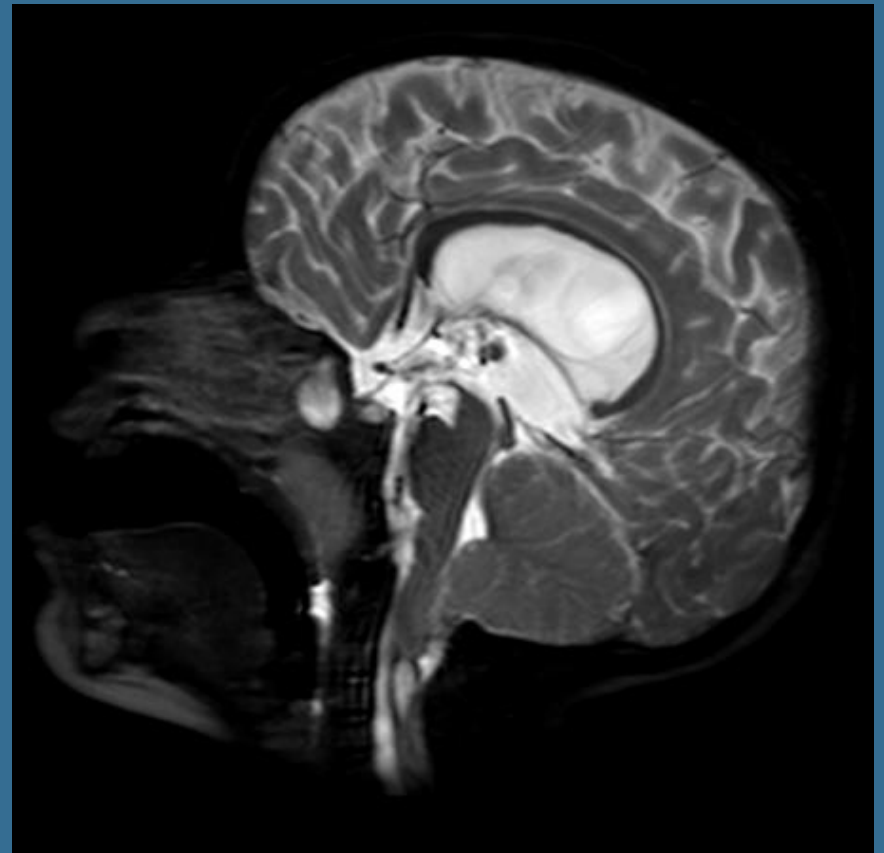
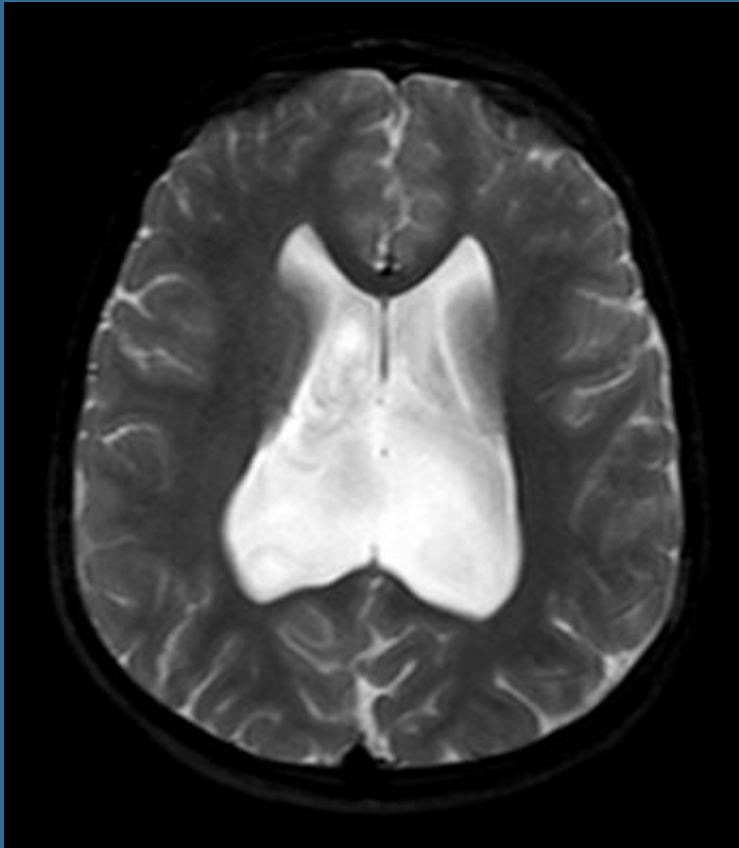
Hydrocephalus, Chiari I, Syrinx: 4 yr 6 mo, 3 d post ETV



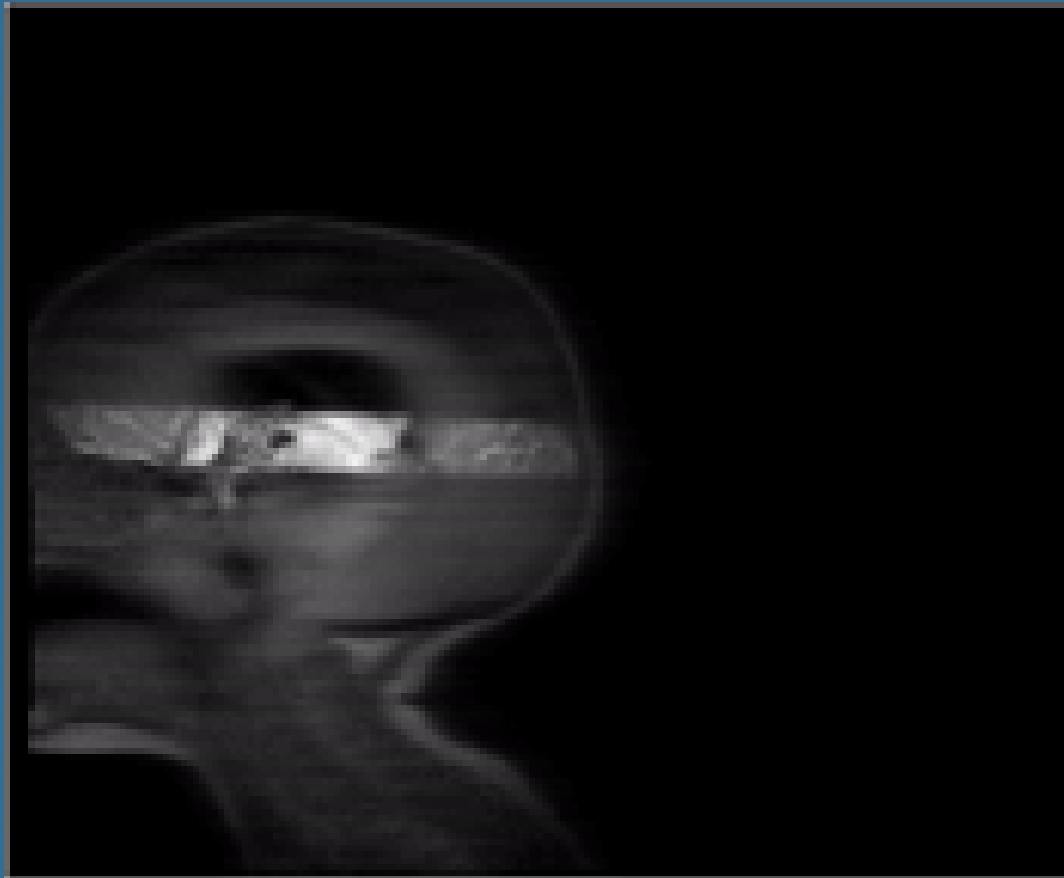
Hydrocephalus, Chiari I, Syrxinx: 5 yr 1 mo, 7 mo post ETV



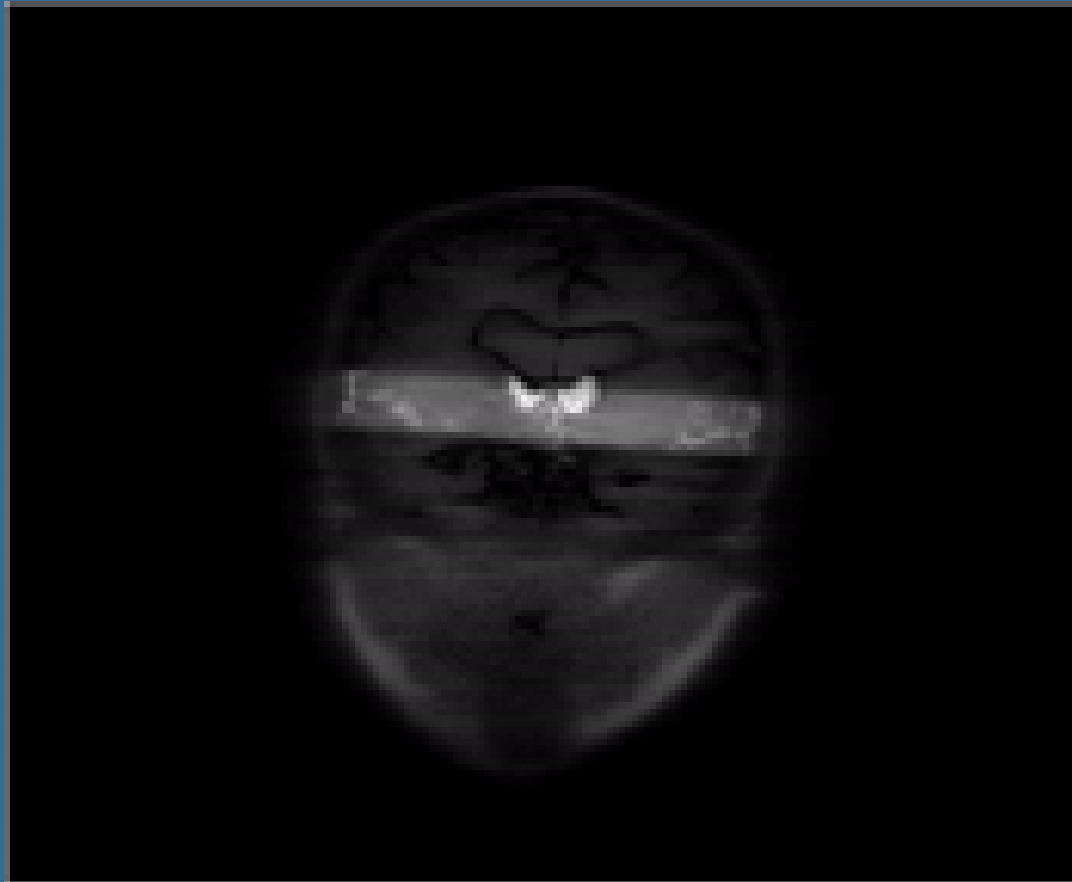
Hydrocephalus, Chiari I, Syrxinx: 5 yr 1 mo, 7 mo post ETV



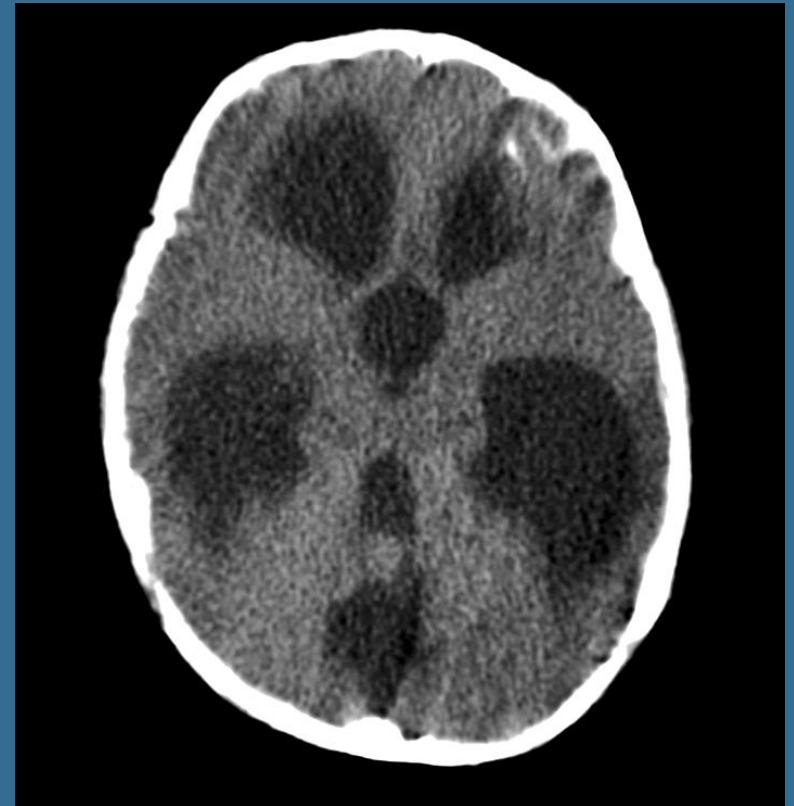
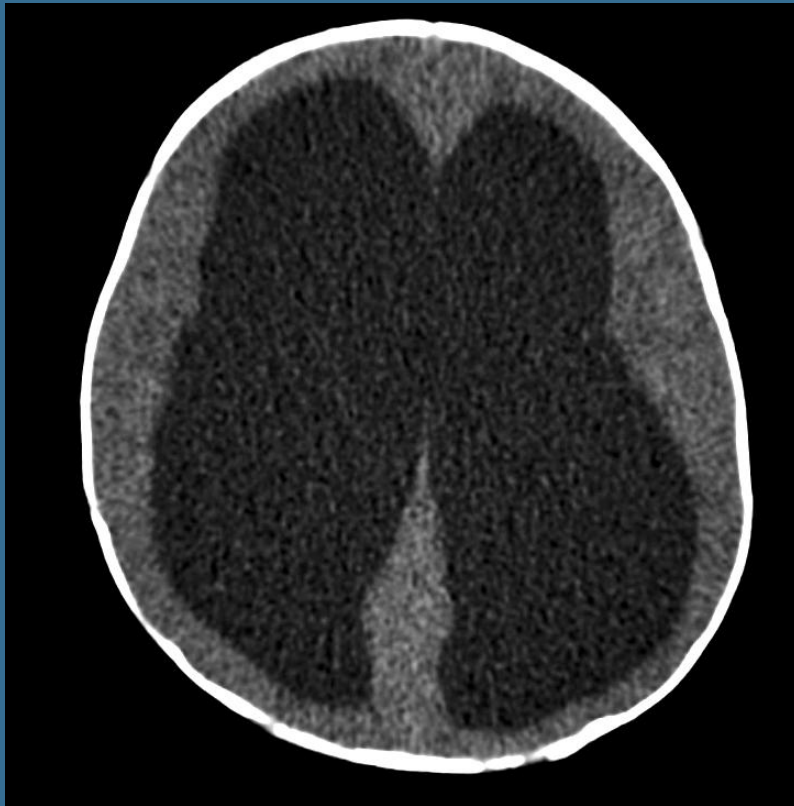
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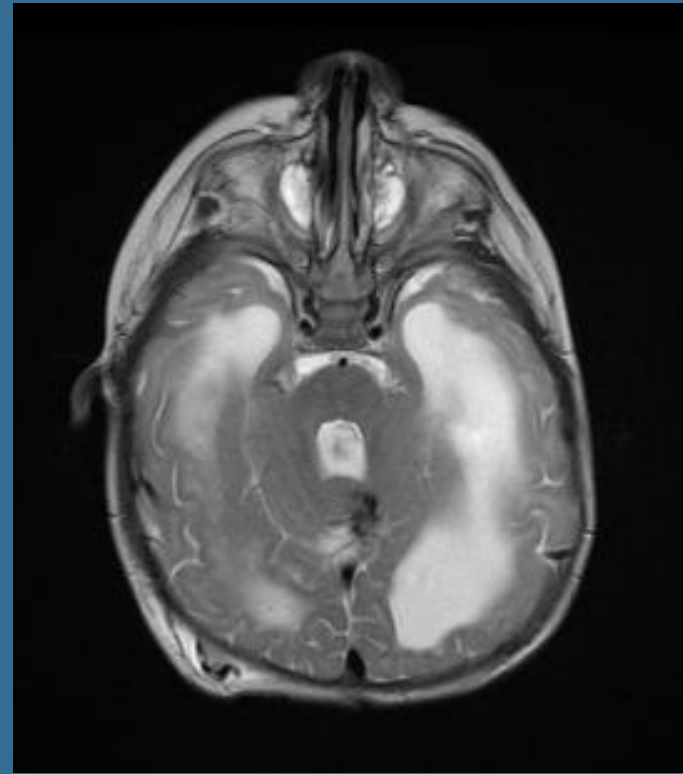
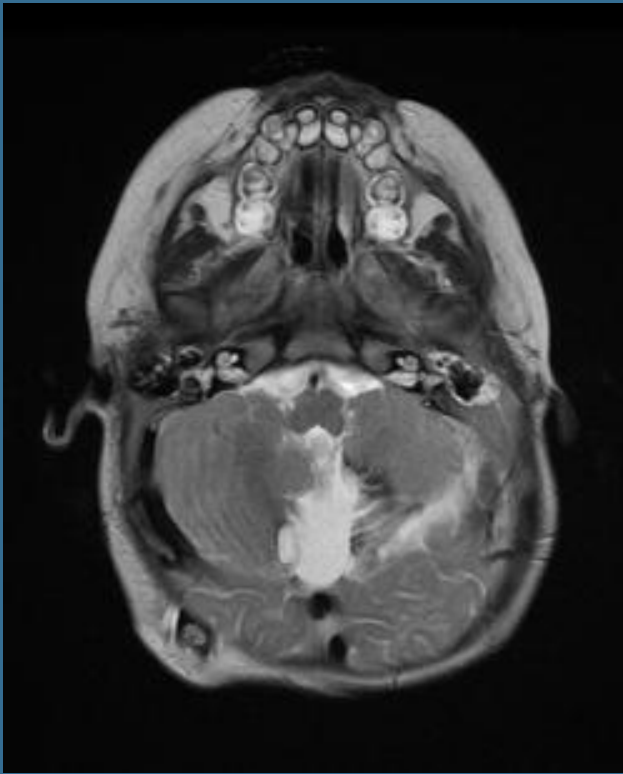
Hydrocephalus, Chiari I, Syrxinx: 5 yr 1 mo, 7 mo post ETV



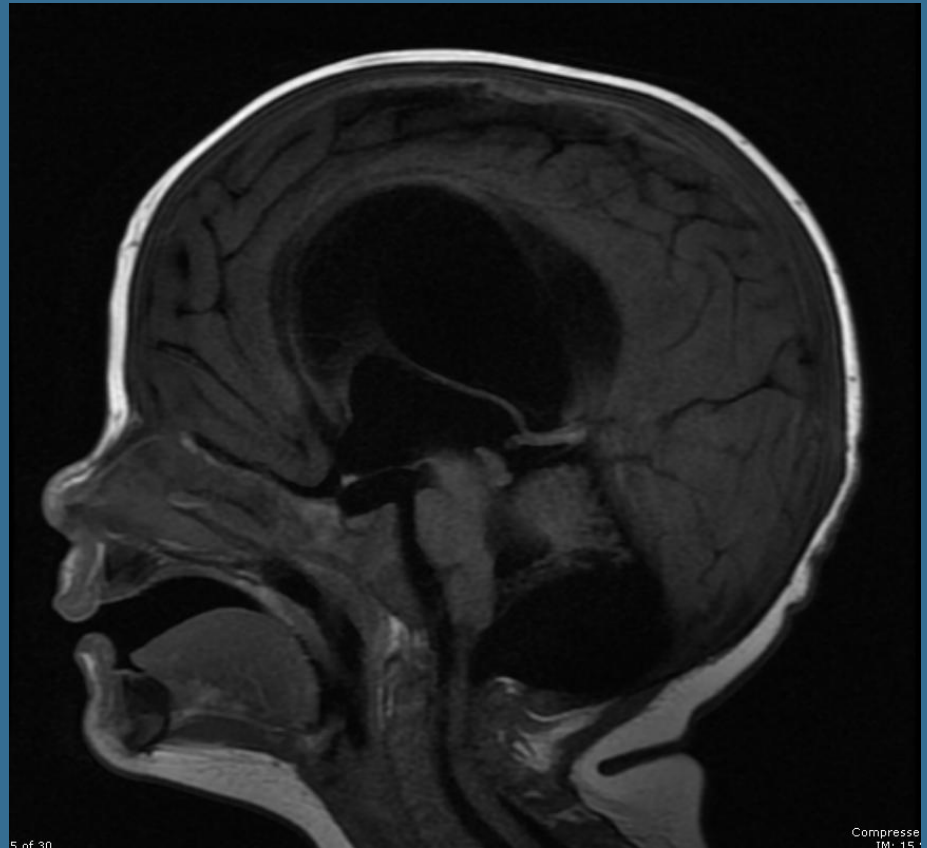
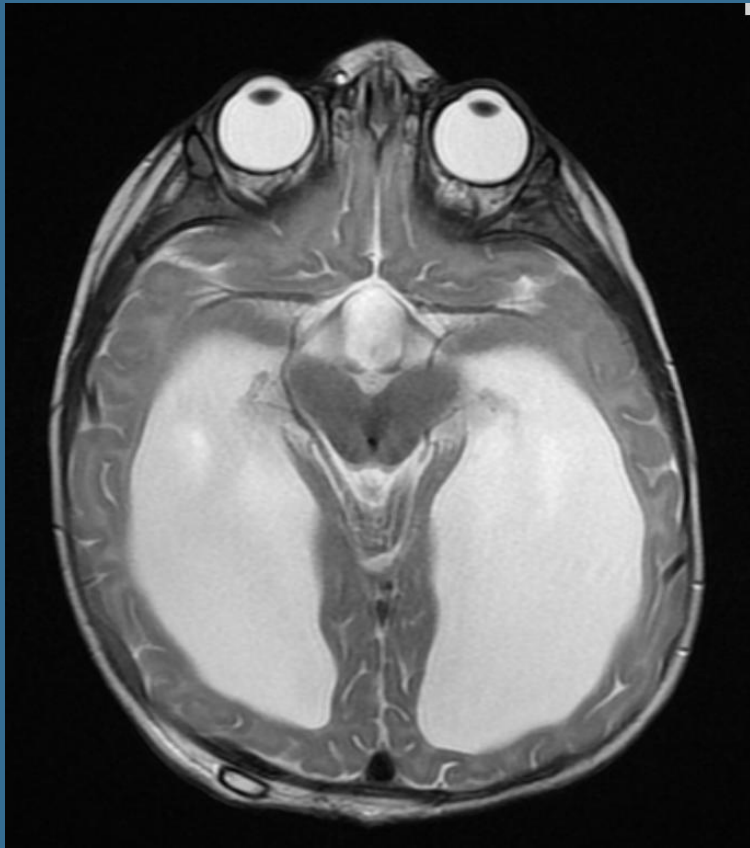
Hydrocephalus: 6 mo, pre shunt



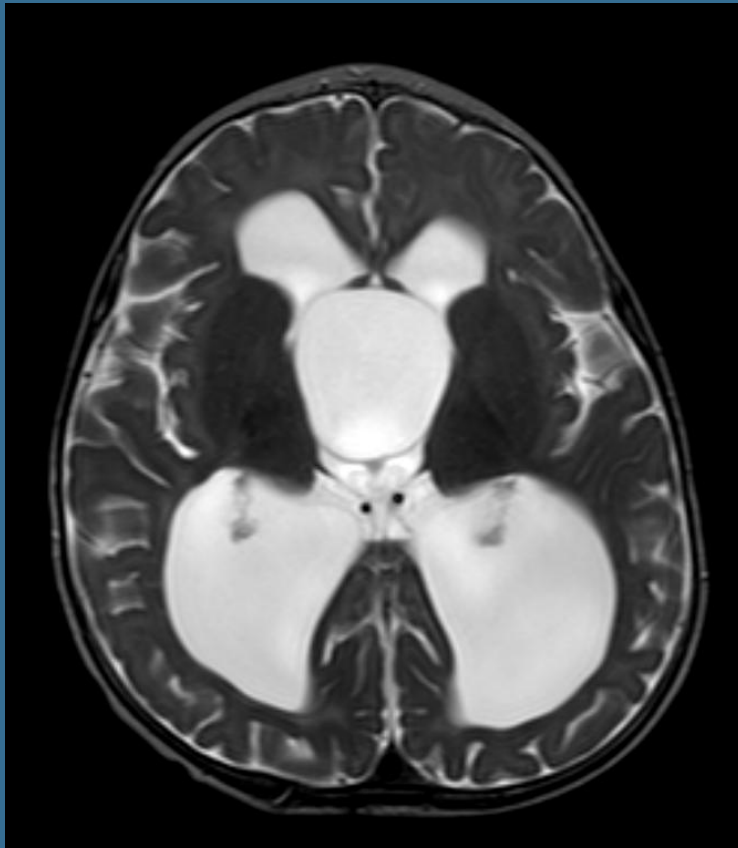
Hydrocephalus: 6 mo; 3 d post shunt



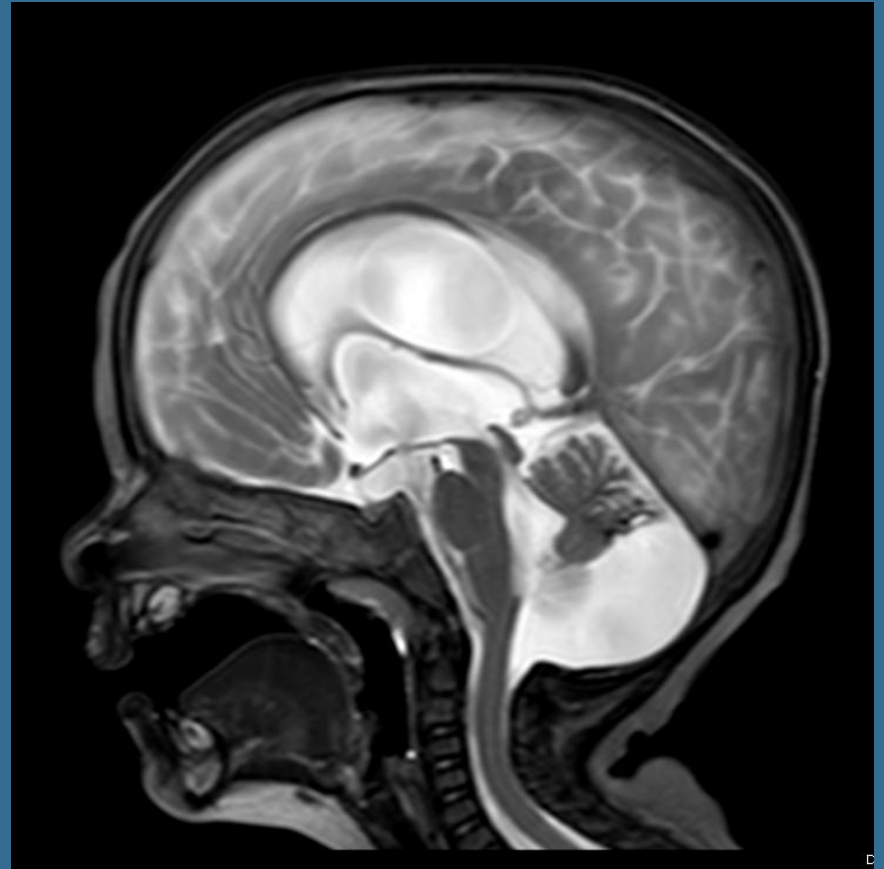
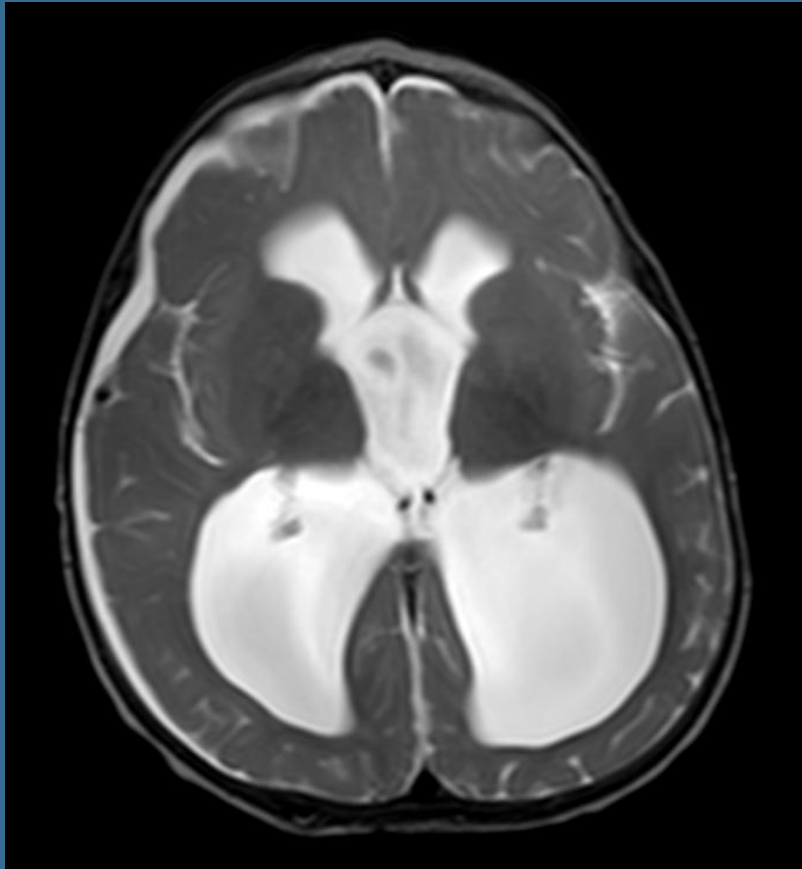
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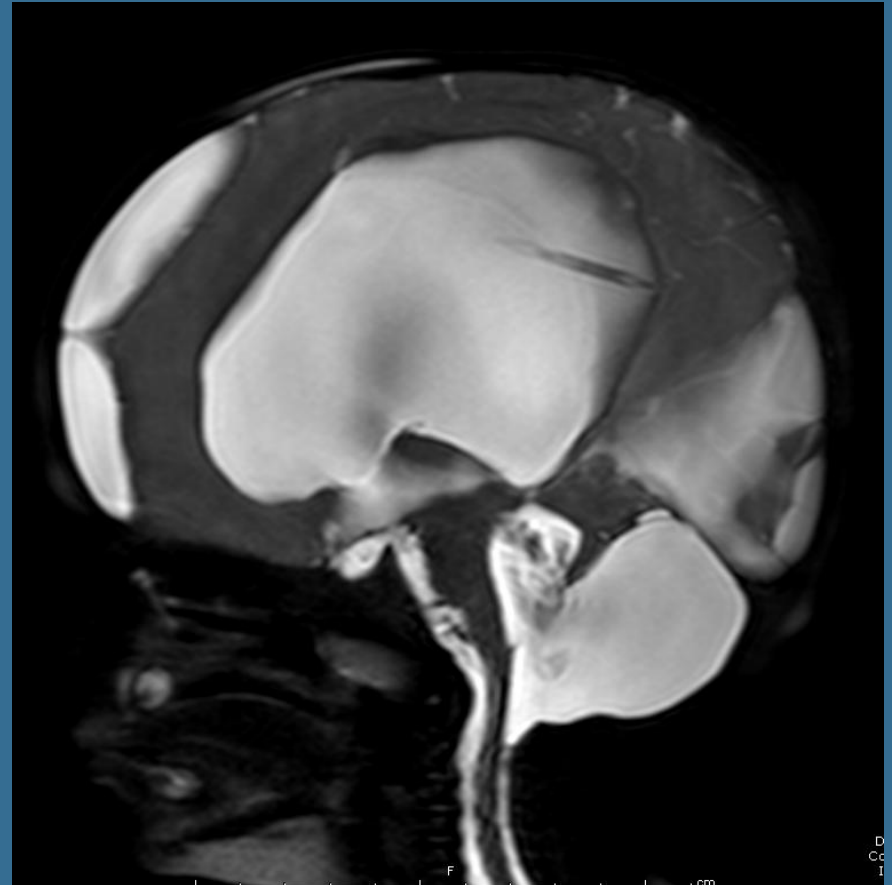
Hydrocephalus, 3rd ventricular arachnoid cyst: 9 mo, pre ETV and cyst fenestration



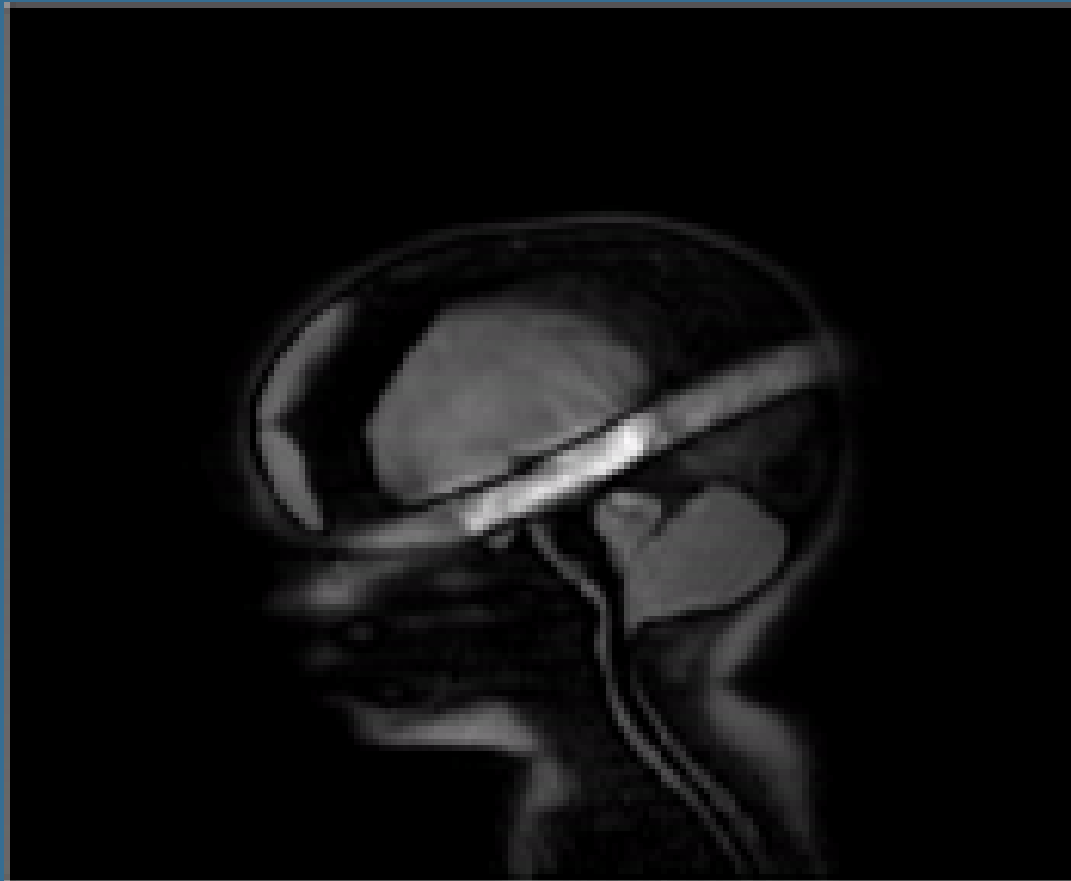
Hydrocephalus, 3rd ventricular arachnoid cyst: 10 mo; 6 d post ETV and cyst fenestration



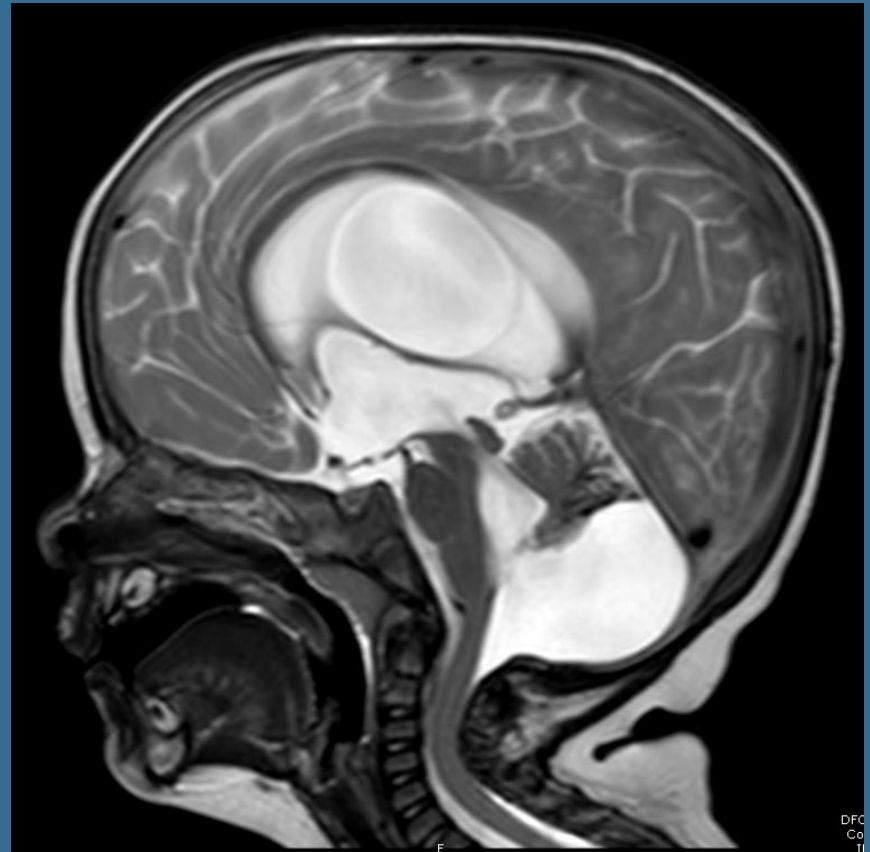
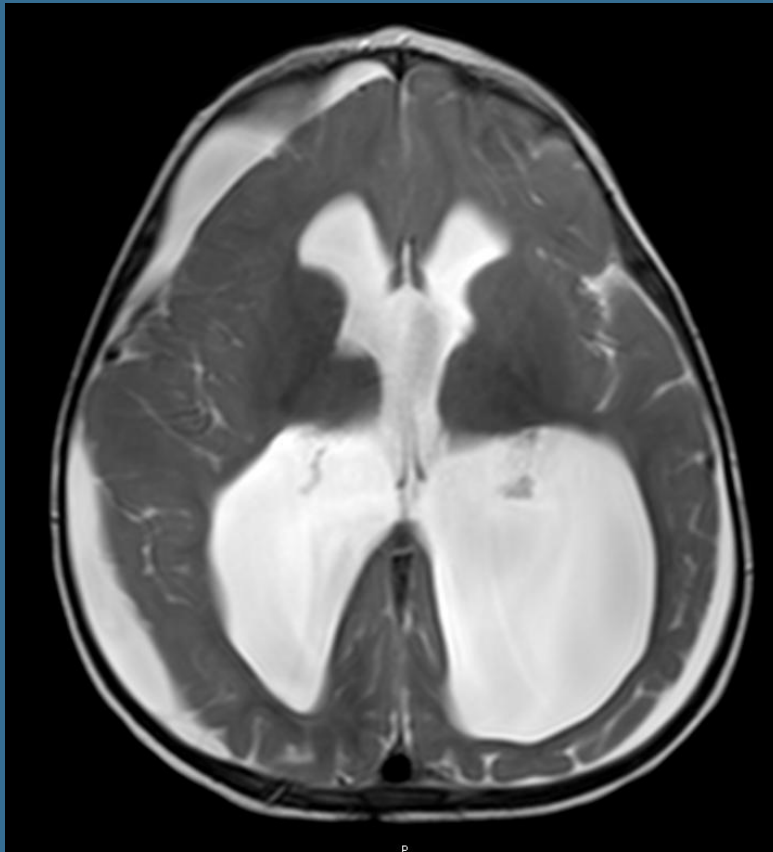
Hydrocephalus, 3rd ventricular arachnoid cyst: 1 yr; pre shunt revision



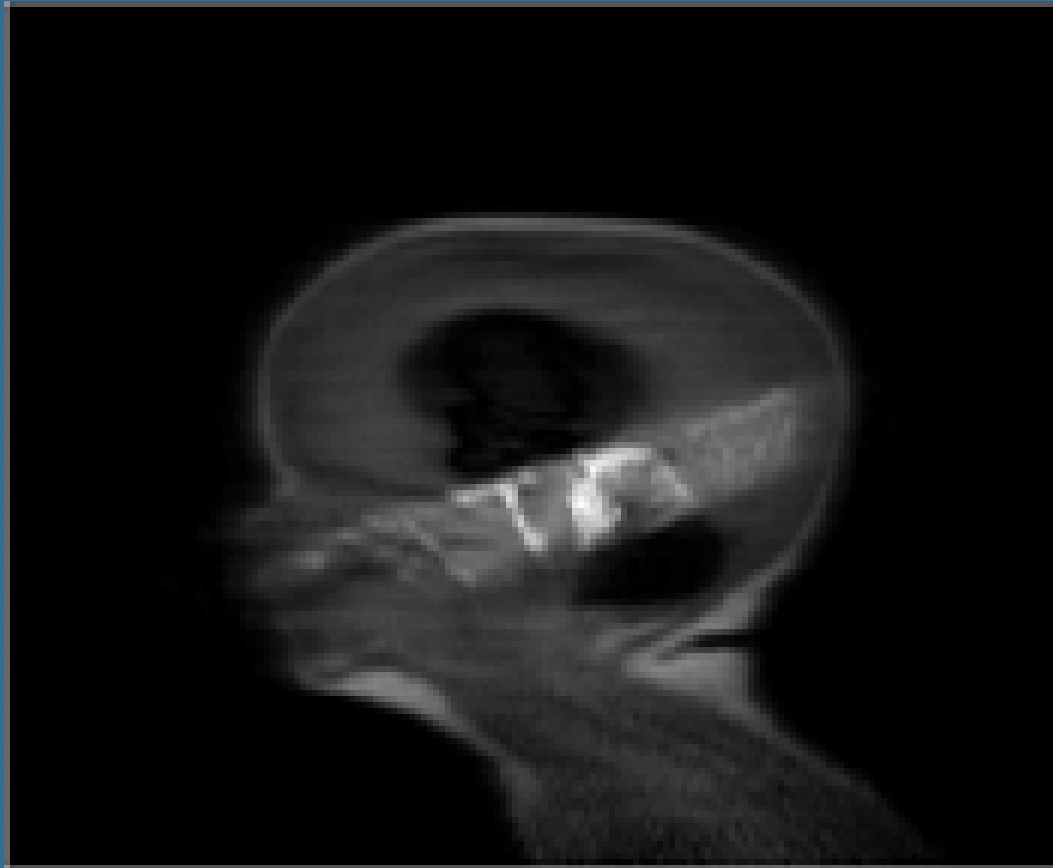
Hydrocephalus, 3rd ventricular arachnoid cyst : 1 yr; pre shunt revision



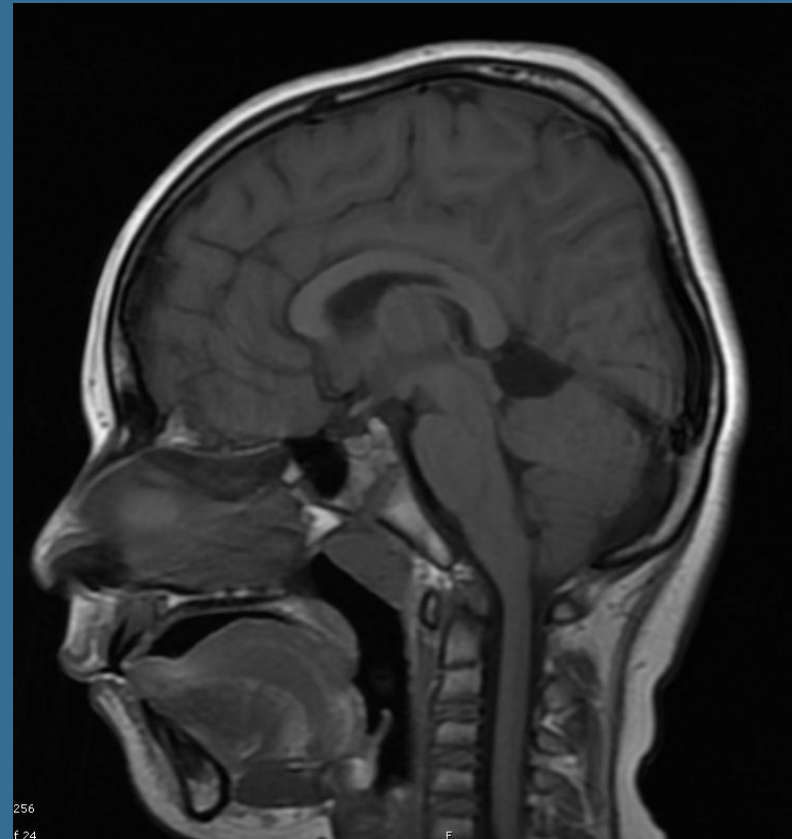
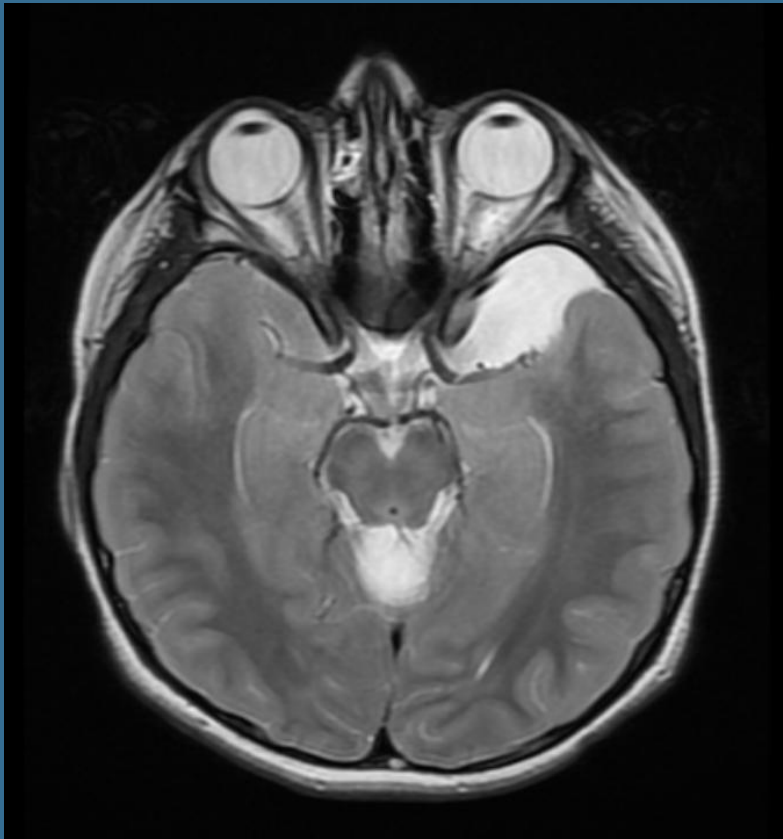
Hydrocephalus, 3rd ventricular arachnoid cyst : 1 yr; 1 mo post shunt revision



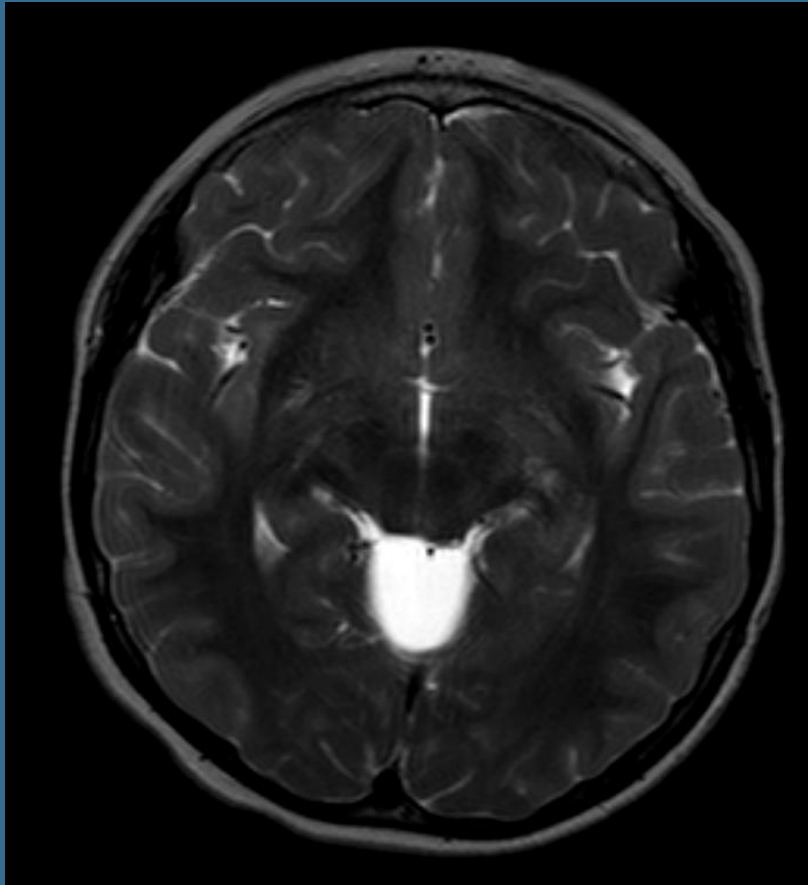
Hydrocephalus, 3rd ventricular arachnoid cyst : 1 yr; 1 mo post shunt revision



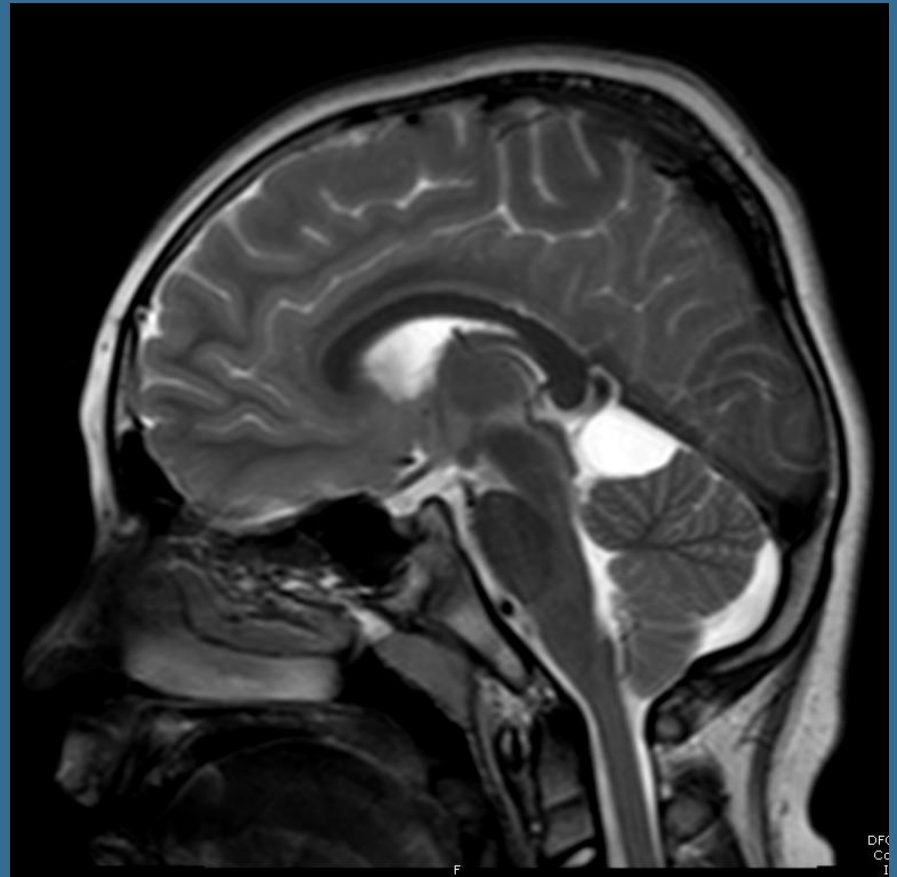
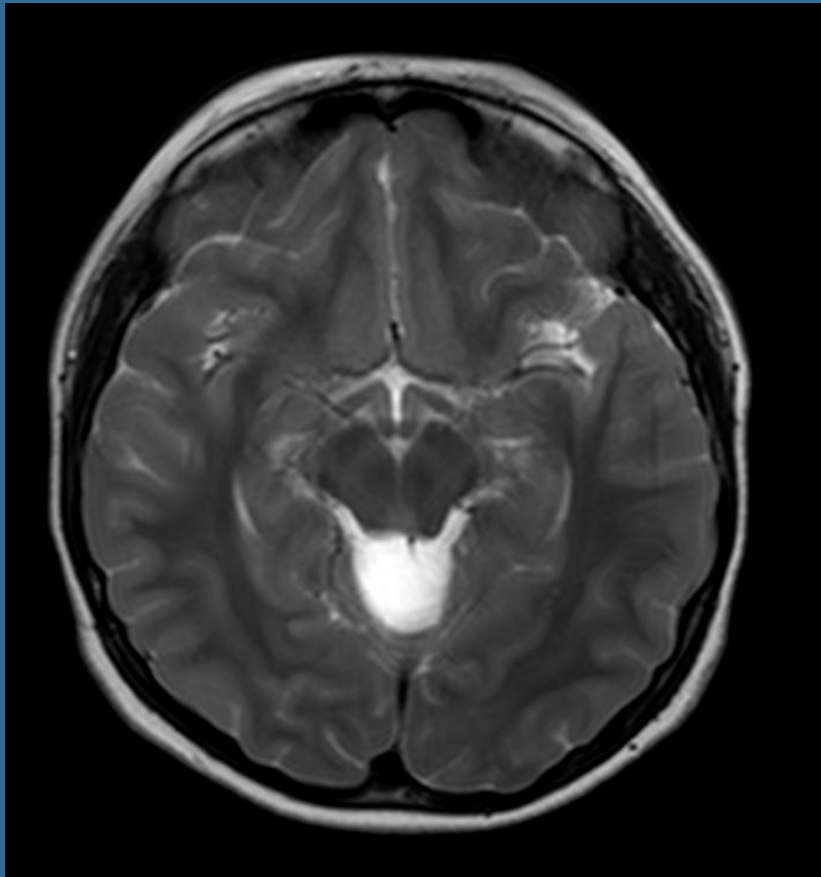
Arachnoid cyst: 6.5 yr



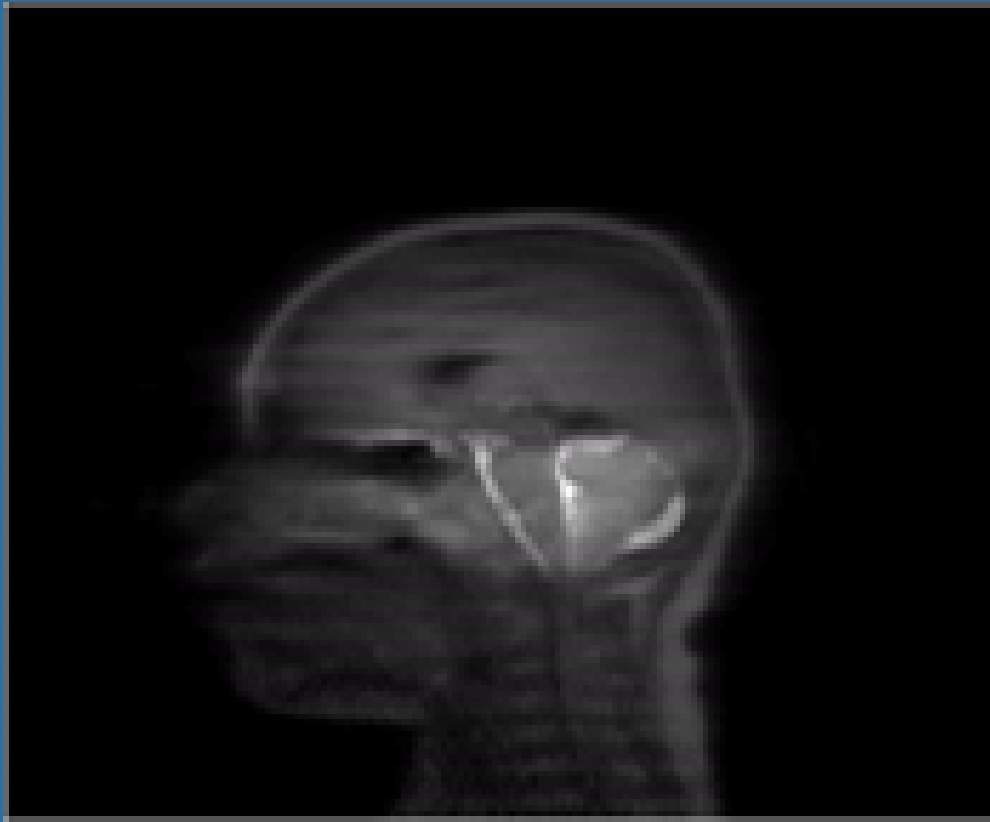
Arachnoid cyst: 7 yr



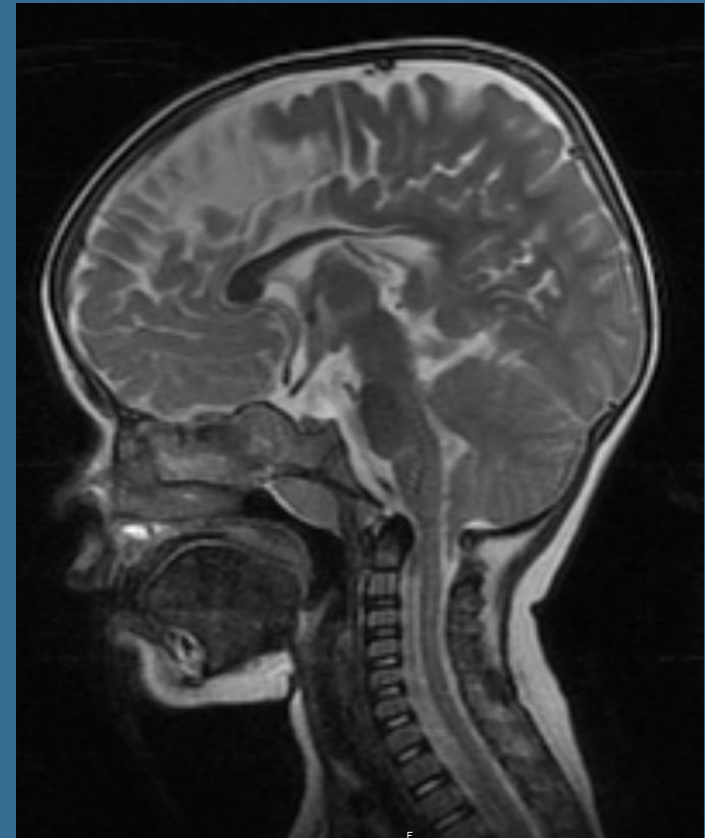
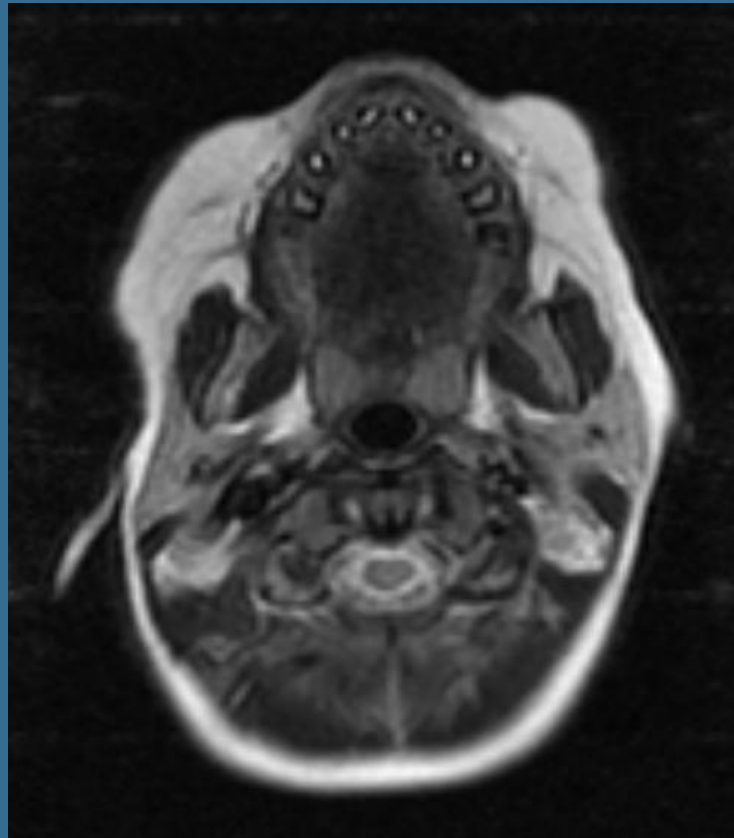
Arachnoid cyst: 7 yr 8 mo



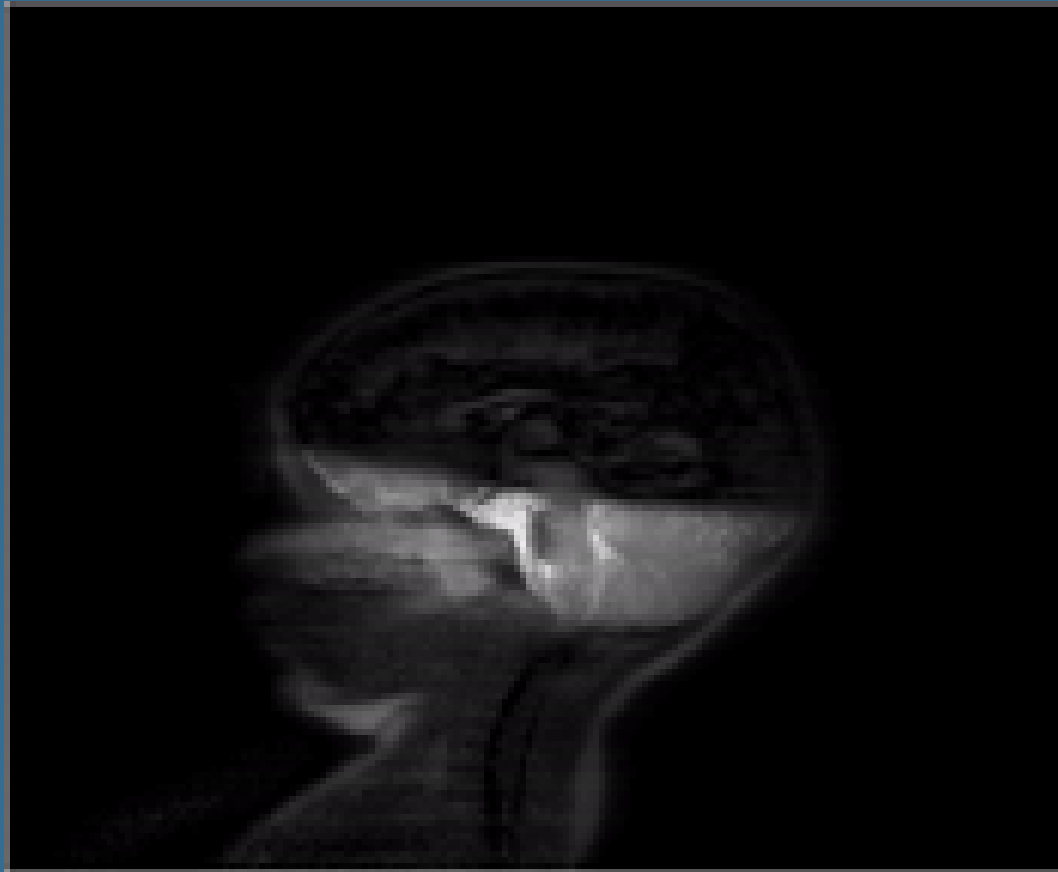
Arachnoid cyst: 7 yr 8 mo



Open NTD, Chiari II, shunted hydrocephalus: 27 mo



Open NTD, Chiari II, shunted hydrocephalus: 27 mo





Can be used anywhere in the
central nervous system where
there is CSF



HYDROCEPHALUS

- Aqueductal stenosis
- Obstruction at the foramina of Monro
- Outlets of fourth ventricle
- Within the ventricular system (multi-loculated)



HYDROCEPHALUS

Define CSF drainage pathways and physiological factors that may alter drainage routes

- Superior sagittal sinus
- Basal cisterns/nerve sheaths



NORMAL PRESSURE HYDROCEPHALUS

- CSF flow through aqueduct
- ? Candidate for ETV
- ? Better determine which patients would benefit from shunting



THIRD VENTRICULOSTOMY (ETV)

- Preoperative evaluation of CSF flow through aqueduct & basal cisterns
- Success of ETV
- Follow-up of patency of ostium



THIRD VENTRICULOSTOMY (ETV)

- ? Subset of patients with hydrocephalus secondary to repaired open neural tube defects (myelomeningocele) who might be a candidate for ETV



VENTRICULOSTOMIES

- Placed for sub-arachnoid hemorrhage, trauma, tumors
- ? help to determine which patients will require a shunt



LOW OR NEGATIVE PRESSURE HYDROCEPHALUS

- Need to drain CSF at zero or a negative pressure, otherwise ventricles enlarge & patient becomes more symptomatic
- Need to decrease size of ventricles
- ? related to change in compliance



CSF LEAKS

- Can be difficult to pinpoint site of leak
- Sometimes not sure if CSF leak is present



ARACHNOID CYSTS

- ? why do they enlarge
 - ? Ball-valve mechanism
- Widened SAS over tip of temporal lobe, or an arachnoid cyst ?
- Determine presence of communication with SAS
- ? large cisterna magna or cyst



ARACHNOID CYSTS

- Monitor success of fenestration
- Why, with what appears to be a good fenestration at the time of surgery, one still needs to place a shunt ?

TUMOR CYSTS

- ? loculated

COLLOID CYSTS

- ? degree of obstruction
- ? movable



PSEUDOTUMOR CEREBRI (BENIGN INTRACRANIAL HYPERTENSION)

- ? CSF problem
- ? Venous drainage problem
- ? Other factors
- ? Multiple causes with various substrates
- ? Effect of optic nerve fenestration



SHUNTS

- ? Able to visualize CSF flow within shunt
- ? Detect shunt malfunction
- ? Overdrainage



CHIARI I

- Observe CSF flow anterior/posterior to spinal cord
- ? Relate to symptoms - headache
- ? Relate to development of syrinx formation
- Post-operative success - especially as to syrinx size

CHIARI I

- ? Movement of CSF in syrxinx & relation to change in size
- Determine if CSF movement at cranio-cervical junction subsequently becomes impaired
- Function of syringo-pleural/peritoneal shunt



SPINAL ARACHNOID CYSTS

- **Diagnosis**
- **Success of fenestration**



CSF MOVEMENT IN RELATION TO POSITION OF PATIENT

- With, but few exceptions, can only image horizontally
- See what changes occur:
 - Sitting
 - Standing
 - Head down

SUMMARY

- Time-SLIP technique enables observation of pulsatile and turbulent CSF flow under normal and pathophysiologic conditions.
- Will enable further understanding of hydrocephalus and its treatment.



Thank you

