

Milestones in pain development

- ◆ 4 wks: Basic structures of nervous system established.
- ◆ 4 wks: Earliest neurons in the cortex are born.
- ◆ 7 wks: Synapse formation begins in cortex.
- ◆ 8-10 wks: Spinal circuitry for pain detection is established.
The fetus is capable of reacting to painful sensory input.
- ◆ 8-10 wks: Subcortico-frontal pathways established.
- ◆ 12-18 wks: Spino-thalamic pathways established.
The fetus is capable of mature pain perception.
- ◆ 22-24 wks: Long-range cortical projections form.
- ◆ *25 years of age:* Cortical circuitry reaches a “mature” state.

Neural circuitry for pain perception is in place by 18 weeks

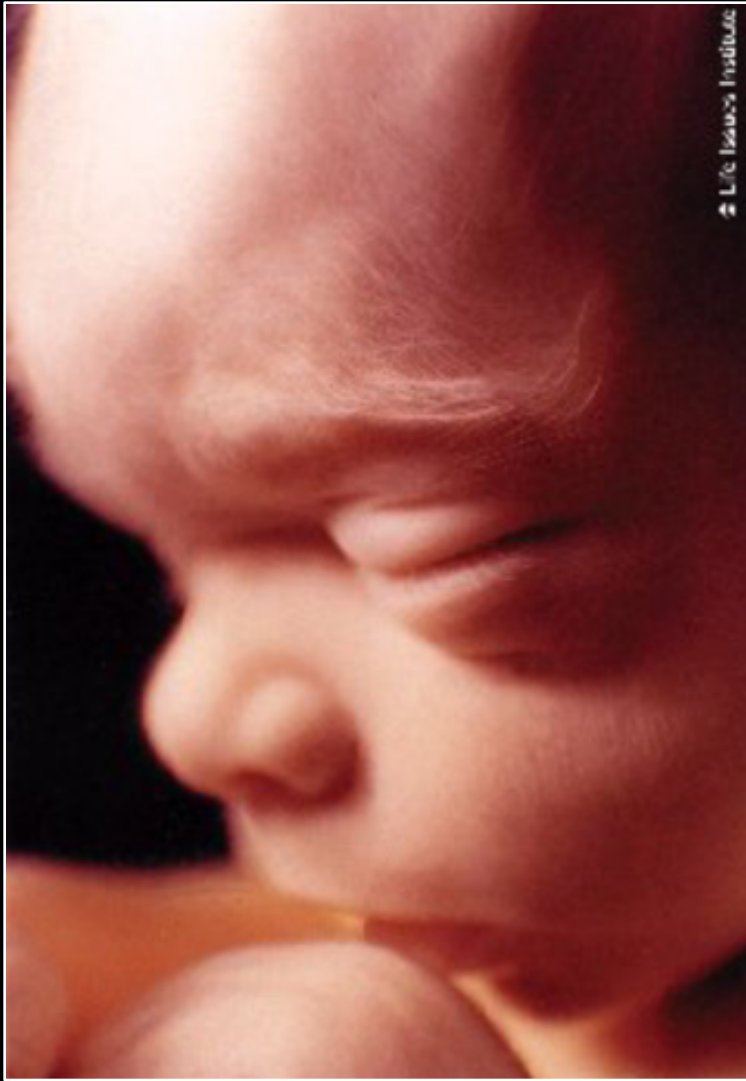


At this stage, thalamic circuitry for pain perception is complete.

At this stage, pain reflexes are established and circuitry for pain perception is developing.



20 weeks post fertilization



Between 22-60% of fetuses born at 20 weeks survive, many without serious complications. Repeated painful experiences at this age have long-term effects on brain development that can be prevented by analgesic medication.



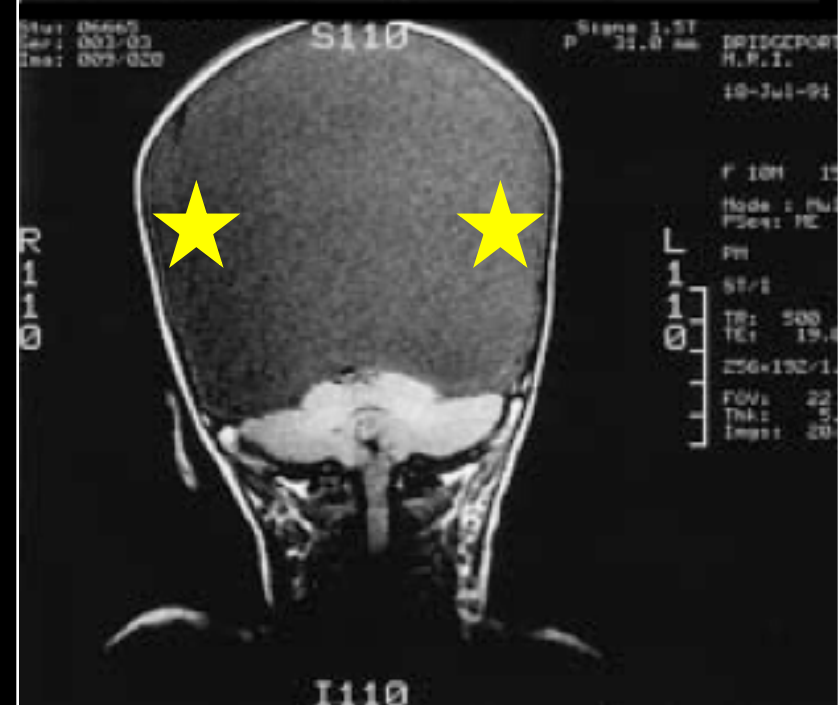
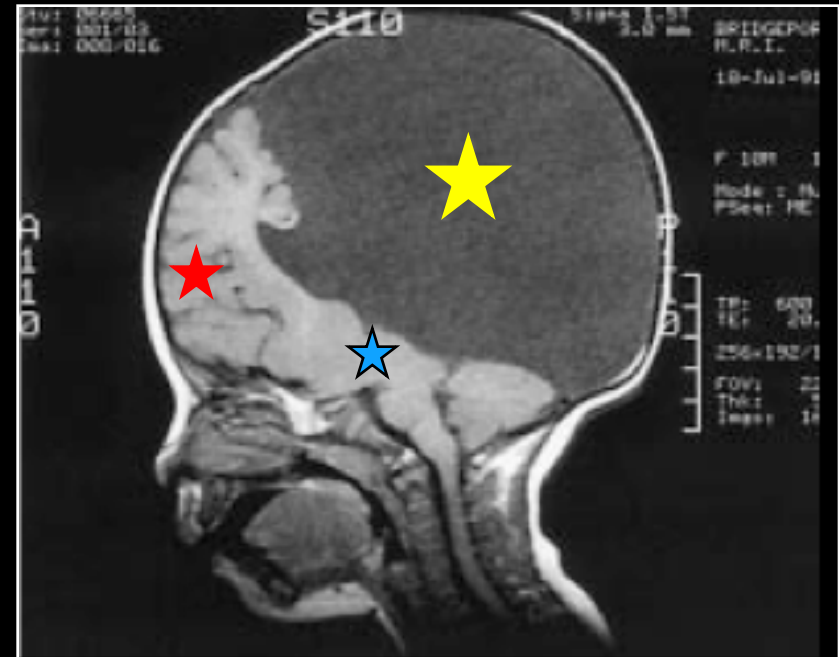
Courtesy of Dr. Colleen Mallory
Neonatology, Northwestern University



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Consciousness in congenitally decorticate children: developmental vegetative state as self-fulfilling prophecy

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Neural correlates of interindividual differences in the subjective experience of pain

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- ◆ Analyzed the responses of 17 normal adult subjects to pain, and categorized their sensitivity as Hi, Moderate or Low.
- ◆ Importantly, ALL subjects experienced pain, yet “Low” sensitivity subjects did not show activation in the regions of the brain RCOG insists are necessary for pain perception and ALL subjects showed activation in the thalamus.

Table 1. Brain regions displaying differential activation between high- and low-sensitivity subgroups

Region	Coordinates (mediolateral, anterior-posterior, and dorsoventral, mm)	High sensitivity	Low sensitivity	Difference between high-sensitivity and low-sensitivity subgroups
ACC (caudal)	−2, 8, 36	Freq = 6, z = 9.38	Freq = 0, z = NS	Freq = 6*, z = 5.50
ACC (perigenual)	−4, 18, 24	Freq = 5, z = 6.58	Freq = 1, z = 4.8	Freq = 4*, z = 3.2
SI	−4, −34, 58	Freq = 4, z = 7.25	Freq = 0, z = NS	Freq = 4*, z = 4.7
PFC	30, 64, 0	Freq = 4, z = 3.75	Freq = 0, z = NS	Freq = 4*, z = 3.76
PFC	32, 62, −8	Freq = 4, z = 3.80	Freq = 0, z = NS	Freq = 4*, z = 3.4
PFC (ventral)	32, 52, −18	Freq = 4, z = 8.21	Freq = 0, z = NS	Freq = 4*, z = 5.98
Thalamus	−18, −20, 14	Freq = 4, z = 6.85	Freq = 3, z = 9.63	Freq = 1, z = NS

Pain Behaviors are seen in premature infants at 23 wks



Courtesy of Dr. Colleen Mallory



Hormonal response to pain



- ◆ Stress hormones are released with needle puncture for blood draw at 20 wks in-utero:
 - ◆ 590% rise in β -endorphin
 - ◆ 183% rise in cortisol
- ◆ Pain response is identical for a 20 wk fetus, a premature infant (20-35wks) and an adult.

Courtesy of Dr. Colleen Mallory

Established evidence ignored by RCOG

1. Animals that naturally lack a cortex are conscious and experience pain
2. Pain and consciousness persist after removal of the cortex
3. Humans with absent or severely reduced cortex are conscious and experience pain
4. Impaired consciousness is associated with loss of thalamic activity
5. Cortical circuitry is not essential for emotions or feelings

Established evidence ignored by RCOG

6. Anesthesia-induced loss of consciousness and pain perception are associated with loss of thalamic, not cortical activity
7. Pain perception is not associated with cortical maturation
8. Pain is largely unrepresented in the cortex
9. Pain experience is affected by altering thalamic, but not cortical activity

REVIEW

Fetal pain: implications for research and practice

- How we view fetal pain is as much about the kind of society we elect to be as it is about the experience of the fetus.
- In 1999, Glover and Fisk acknowledged that the evidence regarding fetal experience was limited, yet observed:
“The eighteenth century philosopher, Jeremy Bentham, wrote of animals *The question is not Can they reason?, not Can they talk?, but Can they suffer?*. This caused a change in attitude towards animals and their treatment that is continuing to day, such that in the UK, even frogs and fishes are required by Act of Parliament to be protected by anaesthesia from possible suffering due to invasive procedures. Why not human beings?”