

- [Home](#)
- [About the CVR](#)
- [News](#)
- [Members](#)
- [Seminar Series](#)
- [Conference](#)
- [Resources](#)
- [CVR Summer School](#)
- [Research Labs](#)
- [Training at the CVR](#)
- [Partnering with the CVR](#)
- [Contact Us](#)

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Effects of early correction for infantile esotropia on cerebral sensory and ocular motor development

Infantile esotropia (crossed eyes in infancy) is associated with multiple sensory and ocular motor deficits, including subnormal stereopsis, smooth pursuit and OKN eye movement asymmetry during monocular viewing. These deficits occur as a result of disruption of normal binocular vision development during an early critical period. How might the timing of surgery prevent the development of these deficits? Using non-human primates as a model, we evaluated the effects of early versus delayed correction of prism-induced strabismus on the development of sensory and ocular motor behaviours, as well as their effects on the development of cortical circuits in infant monkeys. We found that: (1) the sensory and ocular motor defects found in infantile esotropia can be produced reliably in normal infant monkeys if binocular fusion is disrupted immediately after birth for several months; (2) these defects could be prevented if correction occurs in a "window" after 3 weeks of age (equivalent to age 3 months in humans) but before 12 weeks of age (equivalent to age 12 months in humans); (3) the behavioral deficits seen in infantile esotropia are associated with abnormalities in the cortical circuits that mediate motion processing, as measured by motion visual evoked potentials (mVEPs); and (4) the strength of behavioral deficits correlates with a decreased number of binocular connections between ocular dominance columns in the primary visual cortex (area V1). Our results provide evidence that early strabismus correction may be beneficial for brain development in human infants.

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