

Key Points

1. Chiari has been linked to several problems with the eyes, such as nystagmus, near-sightedness and lazy eye
2. The cerebellum and brainstem are important in controlling the natural movements of the eye when following something that is moving (smooth pursuit)
3. Study examined the smooth pursuit of 21 Chiari II children and compared them to a group of healthy volunteers
4. Chiari II with nystagmus had abnormal smooth pursuit
5. However, not all Chiari II children did
6. Abnormal smooth pursuit was not related to level of spinal defect or number of shunt revisions
7. Authors believe the problem is due to the actual malformation of the cerebellum and brainstem and not hydrocephalus

Definitions

Chiari II - more severe form of Chiari where parts of the brainstem and cerebellum itself are herniated; associated with spina bifida and frequently hydrocephalus

fovea - small, central part of the retina in the eye which provides the sharpest vision

hydrocephalus - condition involving an excess amount of CSF in the brain

nystagmus - abnormal, rapid, involuntary movements of the eye

ocular - having to do with the eyes

shunt - tube like device implanted to divert CSF from the brain to another part of the body

spina bifida - birth defect where the spinal cord doesn't close properly and protrudes; can result in Chiari II and hydrocephalus

Chiari II Affects Normal Eye Movements

May 31, 2007 -- Chiari has been linked to a number of eye problems, including nystagmus, severe near-sightedness and lazy eye. Now, a team of researchers from Canada, who have previously published on Chiari related eye problems, have found that a subset of Chiari II children have abnormal smooth pursuit.

When a person looks at an object that is moving slowly, their eyes automatically move to stabilize the image of the object and keep it in the center of their focal area. These eye movements are known as smooth pursuit and allow an object to be seen in detail even though it is moving. Smooth pursuit only refers to looking at slowly moving objects and is different than saccades, which is where the eyes move as quickly as possible (or jump) to an object. Saccades results in a momentary disruption of vision, but smooth pursuit does not.

In a study published in the April, 2007 issue of the journal, *Developmental Medicine & Child Neurology*, the Canadian group (Salman et al.) analyzed the smooth pursuit of 21 Chiari II children and compared them to a group of healthy controls. The children ranged in age from 8-19 years and all suffered from hydrocephalus as well as MRI verified Chiari II. None of the children had additional problems which would affect their eyes and potentially their ocular smooth pursuit, and all had corrected vision of at least 20/40. To help control the experiment, none of the children had severe cognitive deficits.

Both the brainstem and cerebellum play important roles in smooth pursuit functioning, so the researchers hypothesized that the Chiari II children would exhibit problems when tested as compared to their healthy counterparts. In addition, the team wanted to see if the level of spinal lesion (the spina bifida opening) or the number of shunt revisions the children had undergone influenced their smooth pursuit performance. To this end, they categorized the children as having upper spinal lesions (6) or lower spinal lesions (15). Similarly, they grouped the children by number of shunt of revisions (see Table 1) which would indicate periods of increased CSF pressure.

Table 1
Number of Shunt Revisions (21 Total Children)

# of Revisions	# of Children
None	5
One	9
Two or More	7

An infrared eye tracking device was used to quantify the smooth pursuit of both the Chiari children and the healthy controls. The device measured eye position and velocity as the children tracked a slow moving sinusoid wave (see Figure 2).

Figure 2
Sinusoid Target



Somewhat surprisingly, the researchers found that only a subset of the Chiari children demonstrated problems with the smooth pursuit task. Specifically, those children with nystagmus - involuntary, rapid eye movements - showed abnormal smooth pursuit as compared to both the healthy controls and the Chiari children without nystagmus. Conversely, neither level of spinal lesion or number of shunt revisions had any influence on whether the children had normal smooth pursuit functioning.

Since the number of shunt revisions was not a factor, the researchers believe that the smooth pursuit problems are not due to hydrocephalus, but rather the malformation of the brainstem and cerebellum. Although they were not able to identify a structural difference between the children with smooth pursuit problems and those without, since every child with pursuit problems also had nystagmus, clearly there is something about their brain structure which is affecting their eye functions.

It is said that the eyes are a window to the soul, but it also may be that the eyes are a window into some of the more subtle effects of Chiari. For now, most of the eye related Chiari research involves Chiari II, it would be interesting to expand the studies that have already been done to Chiari I and adults.

cerebellar tonsils - portion of the cerebellum located at the bottom, so named because of their shape

cerebrospinal fluid (CSF) - clear liquid in the brain and spinal cord, acts as a shock absorber

Source

Salman MS, Sharpe JA, Lillakas L, Steinbach MJ, Dennis M. [Smooth ocular pursuit in Chiari type II malformation](#). Dev Med Child Neurol. 2007 Apr;49(4):289-93.

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