Key Points

1. Recently, increased attention has been played to the role of Tethered Cord Syndrome in Chiari patients
2. There are a number of areas of controversy, including whether TCS can be identified on MRI, and whether the tension from a tight filum at the base of the spine can cause Chiari
3. Study used 12 cadavers to observe the movements of parts of the craniovertebral junction in response to weighted traction at the base of the spine
4. Found minimal movement of the brainstem and upper spinal cord and no movement of the cerebellar tonsils
5. Authors believe this casts doubt on whether a tight filum can actually cause Chiari, but plan animal studies to investigate further
6. Interestingly, the same authors have found a high rate of Chiari among patients with lipomeningocele which acts as a tether at the bottom of the spine

Definitions

caudal - towards the tail or lower end of the body

conus medullaris - cone shaped area at the lower end of the spinal cord

craniovertebral junction (CVJ) - area at the base of the head where the spine and skull meet

distal - refers to a body part further from the center of the body

filum terminale - thread like structure that connects the lower end of the spinal cord to the bony spinal column

lipomyelomeningocele - a protrusion of the covering of the spinal cord through the bony part of the spine; the protrusion is

New Study Casts Doubt On Tethered Cord Causing Chiari

January 31, 2007 -- There has been a buzz recently in the Chiari community regarding tethered cord and its connection to Chiari. Tethered cord refers to when the spinal cord is improperly attached, or tethered to the bony part of the spine, and can cause problems with bladder and bowel function and weakness in the legs.

While those dealing with Chiari II have confronted tethered cord for years, in the last year or so, some doctors and researchers have begun looking at a possible connection between tethered cord and Chiari I. Specifically, they are focusing on what is referred to as Tethered Cord Syndrome (TCS) where a tight filum terminale at the bottom of the spinal cord essentially pulls down on the cord and places it under tension as if it were anchored.

As Chiari & Syringomyelia News has reported, there is a good deal of controversy surrounding TCS. One.htmlect of this controversy deals with whether TCS can be detected by current MRI technology. Much like Chiari was traditionally defined as the cerebellar tonsils herniating at least 3mm - 5mm out of the skull, the radiographic definition of tethered cord has to do with the location of the conus medullaris (a cone shaped area at the lower end of the spinal cord).

While the location of the conus varies among people, if it is located below a certain level relative to the bony vertebra, it is considered indicative of tethered cord. However, also like Chiari, some doctors have begun to question this definition and speculate that a tight filum can cause symptomatic problems without the conus being pulled lower as shown on MRI.

Because of this, some surgeons have begun to section, or cut, the filum in patients with symptoms indicative of TCS, but with no MRI evidence. Interestingly, some of these patients also have Chiari malformations which has led some to speculate that a tight filum can actually *cause* Chiari by forcing the cerebellar tonsils to herniate during development.

The idea that abnormal tension during embryological development hinders the spinal cord from growing out properly, which can result in Chiari was actually first proposed decades ago but fell out of favor until recently. With its recent revival, it is now not clear if TCS is found incidentally with Chiari, actually causes Chiari, or is not even a real clinical entity beyond the traditional MRI based definition.

However, in a recent on-line publication of the journal Children's Nervous System, a well published group from the University of Alabama at Birmingham (Tubbs, Loukas, Shoja, Oakes) has cast doubt on whether tension from a tight filum can actually cause Chiari.

Specifically, the UAB group used cadavers to show that traction at the base of the spinal cord resulted in negligible movement at the craniovertebral junction. The study involved 12 cadavers (less than 6 hours old) who all had normal brains and spines. The scientists exposed both the bottom of the spinal cord and the craniovertebral junction (see Figure 1).

Figure 1

composed of fatty tissue

lumbar - one of the sections of the spine, the lower back region

tethered cord syndrome (TCS) - condition where the spinal cord is improperly attached, or tethered, to the spine

traction - applying a pulling type force or tension

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

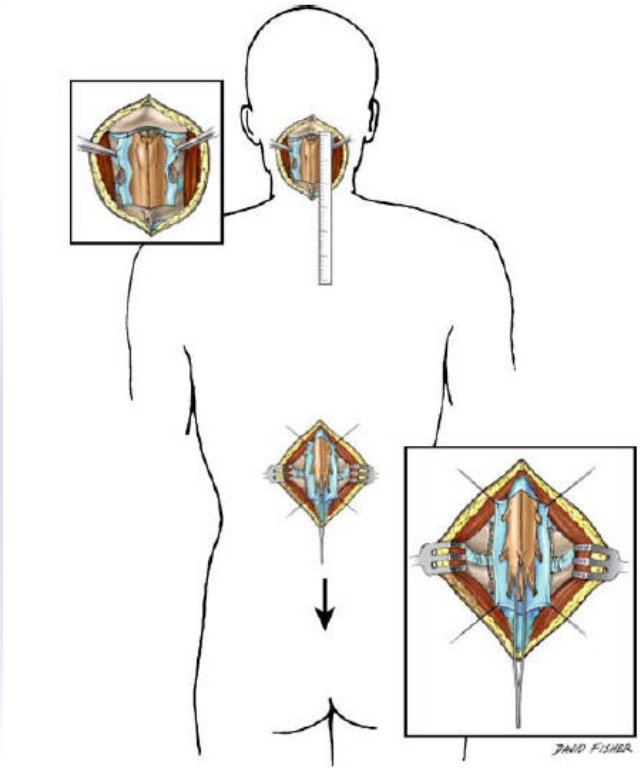
cerebrospinal fluid (CSF) - clear liquid in the brain and spinal cord, acts as a shock absorber

Chiari malformation I - condition where the cerebellar tonsils are displaced out of the skull area into the spinal area, causing compression of brain tissue and disruption of CSF flow

decompression surgery - general term used for any of several surgical techniques employed to create more space around a Chiari malformation and to relieve compression

Source

Tubbs RS, Loukas M, Shoja MM, Oakes WJ. Observations at the craniocervical junction with simultaneous caudal traction of the spinal cord. Childs Nerv Syst. 2007 Jan 4; [Epub ahead of print]



They then applied 16 lbs of tension to the conus medullaris while simultaneously observing the brainstem, the cervical spinal cord, and the cerebellar tonsils. Using a simple ruler, they found that the brainstem and the cervical spine moved less than 1 millimeter and the cerebellar tonsils did not move at all (see Table 1). The researchers also noted that the natural position of the conus medullaris varied in the cadavers from T12 to the top of L2.

While these results would appear to cast doubt on the theory that a tight filum can actually cause Chiari, the authors do note that tension during embryological development may be different than applying tension to the spine of an adult cadaver and they plan to continue their investigation of a possible link using animal studies.

Interestingly, they also point out that this finding in some ways stands in contrast to an earlier study they did which found a high rate of Chiari among patients with lipomyelomeningocele (a fatty version of myelomeningocele or spina bifida). Since the lipomyelomeningocele patients all had normal shaped posterior fossas, the researchers had thought that their Chiari may be due to the abnormal anchoring of the lower part of their spines, but now concede that their current study does not support that theory.

While not discussed in the article, the effect of traction on the spinal cord on the compliance may be an area worth investigating. Recall compliance is a measure of how elastic the spinal compartment is in response to the natural flow of CSF, and has been shown to correlate with symptomatic Chiari. Placing abnormal tension at one end of the spine may in effect pull the dura tight and reduce the compliance of the spinal cord. Whether this would translate all the way up the spine to the craniovertebral junction, and what its long term effects would need to be determined.

Clearly a cadaver study is not the final word on this subject, but it does cast doubt on whether a tight filum can cause Chiari and thus brings into question a procedure to section the filum to alleviate Chiari symptoms (note, this does not mean that sectioning the filum is not beneficial for symptoms related directly to Tethered Cord Syndrome). For now, it appears the link between TCS and Chiari will remain murky at best.

Table 1
Measured Movement At CVJ Due To Traction

Body Part	Movement (mm)
brainstem	<1
cervical spinal cord	<1
cerebellar tonsils	0

Related C&S News Articles:

Minimal Tethered Cord Shows Abnormal Anatomy

Controversy Surrounds Occult Tethered Cord Syndrome

New Surgery Proposed For Chiari