

Key Points

1. There is a growing focus on the role which a tight filum terminale plays in tethered cord syndrome
2. Thick filum is currently defined as greater than 2mm in width or with fatty deposits
3. Case study recently showed that the traction due to a thick filum can cause Chiari
4. This study looked at 6 children with TCS symptoms and examined the filum during surgery
5. Compared to normal controls, the filums were significantly thicker than the healthy group, but did not meet current definition
6. Filums also appeared yellowish and fibrous
7. Current MRI's may not be able to detect abnormal filums which are causing TCS type symptoms

Definitions

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

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

gait - the act of walking

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

section - to cut

spinal cord - bundle of nerve fibers that runs from the base of the brain all the way down the back, through the bony spine

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

urodynamic testing - a series of

Minimal Tethered Cord Shows Abnormal Anatomy

November 20, 2006 -- Tethered Cord Syndrome (TCS) can be caused by (among other things) an abnormal filum terminale. The filum terminale is a thread-like structure which connects the bottom of the spinal cord to the bony spinal column. An unusually thick, or fatty, filum puts an undue amount of traction on the spinal cord, essentially pulling it down, resulting in problems with bladder function, leg weakness, gait problems, and pain.

The current radiological definition of TCS due to a thickened filum involves a filum terminale greater than 2mm in width. Such a filum is also commonly infused with fatty tissue (which shows up on an MRI) which can change its elastic properties. Since the thickened filum pulls down on the spinal cord, doctors also look at where the conus medullaris - at the lower end of the spinal cord - is located relative to the bony vertebrae. While there is a range of what is considered normal, a conus located below the second lumbar vertebra (L2) is considered to be low and an indication of TCS. Treatment for this type of TCS involves sectioning, or cutting, the filum to release the tension on the spinal cord.

Interestingly, some researchers have begun to link TCS to Chiari. Recently, a Spanish neurosurgeon put forth the idea that the herniation of Chiari is actually caused by the downward traction of a tight filum terminale. While a number of Chiari patients have been found to also have TCS, his idea has not been widely accepted. However, as reported in this issue of C&S News, a case report was published with documented, via MRI, an acquired Chiari malformation due to a thickened filum.

While the radiological definition of TCS due to a thickened filum is widely accepted, recently a number of doctors have begun to question this definition of TCS. There is little doubt that someone who exhibits a thickened filum or low-lying conus on MRI has a problem, however, as reported in the September issue of C&S News, some in the medical community are beginning to question whether people can have TCS due to an abnormal filum which does not show up on MRI. This is referred to as occult TCS and remains a controversial topic.

Some doctors advocate sectioning, or cutting, the filum in children with TCS type symptoms, usually severe bladder problems validated by urodynamic testing, while others remain opposed to such an approach and dismiss the notion of occult TCS altogether. Now, a group out of Oregon led by Dr. Nathan Selden has weighed in on this controversial topic with a study published in the September, 2006 issue of the Journal of Neurosurgery: Pediatrics.

Based on recent publications which showed that more than 90% of patients who underwent sectioning of the filum without MRI evidence of TCS experienced positive clinical outcomes, the Oregon group hypothesized that either children with minimal TCS have abnormalities that are not shown on MRI, or that such children are prone to problems due to a normal level of spinal tension from a normal filum.

To investigate, the team reviewed cases at their facility from between June, 2000 and November, 2004 which involved sectioning of the filum to release the spinal cord. They identified 89 such cases during that time period, including six children (ages 5- 12) with no MRI evidence of tethered cord. Five of the children had been referred due to intractable urinary problems, while the sixth had extreme leg weakness and muscle atrophy with moderate bladder problems. The researchers also formed a control group for comparison comprised of three children who had their healthy filums sectioned as part of unrelated surgical procedures.

As the basis for determining whether the filums were normal or abnormal, the researchers photographed the filums during surgery, along with a physical reference, so they could measure the thickness post-operatively. In addition, a small piece of tissue was removed during the procedure for pathological examination.

When they reviewed the data, the scientists found a striking difference between the thickness of the suspected TCS patients versus the controls. While both groups had filums less than 2mm thick, the average filum thickness of the TCS group was more than twice that of the normal group (See Table 1, 1.24mm vs 0.57mm). In addition, there was no overlap in terms of the thickness of each group. In other words, every child in the TCS group had a filum thicker than 0.8mm, while the thickness for every child in the control group was less than 0.8mm.

When they examined the tissue samples after surgery, they also found significant differences between the groups. Specifically, they found that the filums of the TCS group were comprised of more dense, fibrous tissue than the healthy controls.

In terms of outcomes, all patients improved during follow-up which ranged from 3 to 30 months. The bladder improvement was considered mild in two of the children and moderate to marked in the remaining four.

tests which evaluate how well the bladder works

Common Chiari Terms

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

cerebellum - part of the brain located at the bottom of the skull, near the opening to the spinal area; important for muscle control, movement, and balance

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

Selden NR, Nixon RR, Skoog SR, Lashley DB. [Minimal tethered cord syndrome associated with thickening of the terminal filum.](#) J Neurosurg. 2006 Sep;105(3 Suppl):214-8.

While the number of patients involved in this study was very small, the findings do add credibility to the argument that current MRI techniques are not always able to identify abnormal filums which are putting the spinal cord under too much tension. What would be useful would be a way to non-invasively measure the tension of the filum terminale and in this way determine what is normal and what is problematic.

There appears to be a strong link, and in some cases maybe even causative, between Chiari and TCS due to an abnormal filum, and as such it will be important to monitor developments in the diagnosis and treatment of TCS.

Table 1
Average Filum Thickness, TCS Group vs Control Group

	TCS	Control	Sig?
Filum Thickness (mm)	1.24	0.57	Y

Notes: *Sig?* refers to the result being statistically significant, meaning it is not likely due to chance
No TCS patient had a filum less than .8mm thick; no control patient had one greater than .8mm thick

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