Key Points

1. Several studies over the past 15 years have shown that people with Chiari have smaller posterior fossas
2. This study compared MRI measurements of the posterior fossas of 60 people with Chiari and compared them to 30 healthy people
3. Found that on average Chiari patients had smaller posterior fossas, but wider foramen magnums
4. Study supports previous work and adds to the theory that Chiari I is actually caused by a lack of bony development and is not a neural tube defect
5. It would be interesting to compare similar MRI measurement within a Chiari patient group to see if they are related to presence of SM, symptoms, etc.

Definitions

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

clivus - bony surface which defines one of the boundaries of the posterior fossa area

control - in a study, a group of subjects, usually healthy, which serve as a means of comparison

decompression surgery - general term used for any of several surgical techniques

Chiari Link To Small Posterior Fossa Confirmed In Adults

September 15, 2005 -- One of the underpinnings of the scientific method is the repeatability of experimental results. In other words, an experiment, to be of value, should produce the same results when run over and over again. In physics, this means that every time the force of gravity is measured by how quickly an object falls, it should produce the same result. In the medical field, it means that the same type of experiment, or trial, performed by different researchers with different subjects, should produce the same results. This repeatability serves as a check against results that might be a fluke, poor experimental design, misinterpretation of results, and scientific fraud.

As an example of the importance of repeatability, several years ago two scientists made headlines around the world by claiming they were able to achieve what is known as cold fusion - a way to produce energy very cheaply. Unfortunately, despite the massive hype which followed, other scientists, from around the world, were not able to duplicate their results. A firestorm of controversy erupted with claims and counterclaims occupying the headlines for quite some time. The media's attention eventually turned elsewhere, with the result being that most scientists now discount the reported cold fusion results due to lack of repeatability.

In the world of Chiari research, repeatability can also be difficult to achieve. Often, published papers are not the results of rigorously designed experiments, but rather the results of a series of patients, or even the interesting case of a single patient. The reporting physicians often use different measures of data collection and different definitions of success, making it difficult to combine results and draw conclusions such as the success rate of surgery.

Despite variations in implementation, there is mounting evidence from several studies that despite it's name referring to the cerebellum, Chiari is really due to lack of bony development in the skull, which results in a space which is too small to accommodate a normal brain.

The region of the skull where the cerebellum is situated is referred to as the posterior fossa. Several researchers, using slightly different techniques, have shown that Chiari patients on average have smaller posterior fossas than healthy people.

In 1993, Stovner compared the skull dimensions of 33 Chiari patients to 40 healthy controls, and found that, "the posterior cranial fossa was significantly smaller and shallower in patients than controls." Similarly, in 1997, Nishikawa devised a volume ratio to study whether the brain was crowded in the posterior fossa region of 30 Chiari patients versus 50 healthy controls. He found that despite the actual brain volume being about the same between the two groups, there was significantly more crowding in the Chiari patients than the control subjects. Additionally, in 1999, Milhorat found in his landmark study that the posterior fossa volume of 50 Chiari patients, as measured by MRI, was smaller than that of 50 matched control subjects.

Now, Dr. Sabri Aydin and colleagues from the University of Istanbul, add to this body of evidence in a report published in the September, 2005 issue of the journal, Surgical Neurology. In their study, the Turkish team used MRI's to make 5 straight-line measurements in the posterior fossa region (see Table 1). Specifically, they measured:

1. The length of the supraocciput
2. The front-to-back diameter of the foramen magnum
3. The length of the clivus
4. The front-to-back diameter of the posterior fossa
5. The height of the posterior fossa

The team compared the skull measurements of 60 adult Chiari I patients they had treated and compared them to 30 healthy, adult control subjects. The Chiari patients represented a fairly typical sampling with 36 women compared to 24 men and an average age of 35. Interestingly, almost two-thirds of the Chiari group reported suffering from life-long symptoms. Additionally, all Chiari patients had herniations of at least 5mm and 76% had syringomyelia as well. The control subjects were selected from people who had had MRI's because of headaches, but for which nothing abnormal was found.

The results showed that except for the diameter of the foramen magnum - the opening at the base of the skull where the spine comes in - all other measurements were smaller among the Chiari group as compared to the control group (see Table 2). As a matter of fact, statistically speaking, most of these measurements were significantly smaller in the Chiari group. This means that the results are not likely to be due to chance.

employed to create more space around a Chiari malformation and to relieve compression

ectopia - when a body part is out of position; tonsillar ectopia is another name for Chiari malformation

foramen magnum - opening at the base the skull where the brain and spine connect

magnetic resonance imaging (MRI) - diagnostic device which uses a strong magnetic field to create images of the body's internal parts

morphometric - measurement and analysis of the shape of things

posterior fossa - depression on the inside of the back of the skull, near the base, where the cerebellum is normally situated

syringomyelia (SM) - neurological condition where a fluid filled cyst forms in the spinal cord

supraocciput - one of the boundaries of the posterior fossa region

syrinx - fluid filled cyst in the spinal cord

tonsillar herniation - descent of the cerebellar tonsils into the spinal area; often measured in mm

vertebra - one of the individual bones of the spinal column

Source

Aydin S, Hanimoglu H, Tanriverdi T, Yentur E, Kaynar MY. Chiari type I malformations in adults: a morphometric analysis of the posterior cranial fossa. Surg Neurol. 2005 Sep;64(3):237-41.

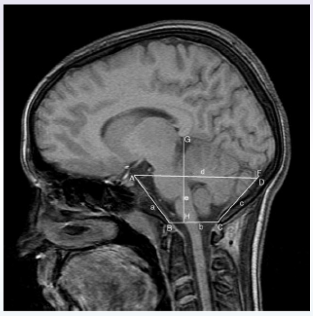
Interestingly, the size of the foramen magnum - the opening through which the cerebellar tonsils descend in Chiari patients - was significantly wider in the Chiari group than the healthy group.

These results further support the earlier findings and provide additional evidence that Chiari I is actually a result of the lack of proper development of the back of the skull, which results in crowding and a downward displacement of the cerebellum. Despite this, it is still not known how symptoms are triggered and how to objectively define a Chiari malformation. In the words of the authors of this study, "[our understanding of Chiari] remains frustratingly incomplete."

All the studies cited in this article compared posterior fossa measurements between Chiari patients and healthy controls. It would be interesting to apply the same type of analysis within the Chiari community. Do children with Chiari II, thought to be related to the neural tube defect spina bifida, also demonstrate small posterior fossas? Is there a link between the size of the posterior fossa and the presence of syringomyelia? Is there a connection between the amount of crowding and the severity of symptoms?

As with so many questions about Chiari, only time and money will tell.

Table 1
Graphical Representation of MRI Measurements Taken



Notes: White lines represent where measurements were taken; MRI image shown is of a healthy subject

Table 2
Summary of MRI Measurements, Patients vs. Control Subjects

Measurement Avg. in mm	Chiari	Control	Sig?
Supraocciput	42.1	46.7	N
Foramen magnum	31.7	25.2	Y
Clivus	39.0	48.4	Y
Posterior Fossa Diameter	60.4	74.7	Y
Posterior Fossa Height	124.7	141.2	Y

Notes: Sig? refers to whether the difference between the Chiari and control groups is statistically significant; for all the measurements that were, the probability that the difference was due to chance was less than 0.1%, a very strong result

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