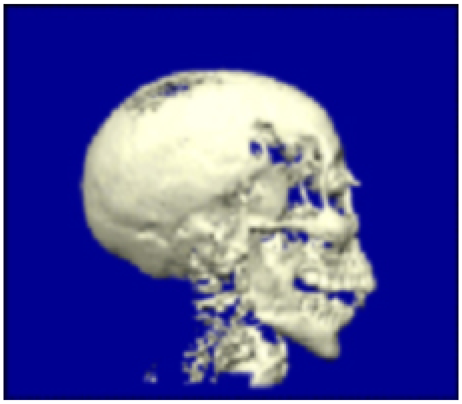
Is Your Head Flexible?



When someone says you have a hard head, they mean you're stubborn. But, it's also a reference to how rigid the human skull is—or is it? Researchers have learned that the bones in the human head move ever so slightly as pressure inside the skull increases. This discovery has a big effect on both astronauts and medical patients on the ground.

When astronauts travel into space, they may suffer **nausea**, vomiting, and swelling in the upper body and head. In the reduced gravity of space, their bodies continue to function as they do on Earth. Because gravity is not pushing fluids into the lower areas of the body, fluids become unbalanced and distributed more into the upper areas of the torso. This is called space adaptation syndrome (SAS) and reflects the changes in intracranial pressure (ICP)—pressure within the head. The pressure changes are real, but it has always been very hard to see inside someone's head to monitor that pressure. Up to 40 percent of astronauts develop SAS in their first few days in space. Being able to monitor changes in intracranial pressure will help researchers better understand how and why this happens, and then, how to prevent it.

ICP happens on Earth, too. Every year, nearly 400,000 Americans are treated for head injuries, conditions involving blood supply in the brain, and brain tumors. When bodies are injured, swelling is the natural way to protect the injured area. When the brain is injured, however, there isn't much extra room for swelling inside the skull. The pressure from the swelling can cause major body functions to shut down. This can cause patients to **lapse** into a coma. To measure the swelling, doctors drill a hole into the patient's head and insert a needle or catheter into the brain. Drilling is an invasive method that can complicate a patient's situation. Many doctors would prefer to find a less **traumatic** way to monitor pressure in the brain.

NASA has developed a type of ultrasound method to monitor intracranial pressure by measuring the subtle movements of the skull. Most people think the skull is a rigid container that doesn't change in size or volume. It's been shown, however, that the skull moves with changes in ICP. The movement is so small that it is not even detectable to the human eye. The movement is only a few micrometers—and it takes 1,000 micrometers to make 1 millimeter. That slight movement, though, can tell the experts a lot. Sending an ultrasound wave through the skull gives researchers the keys they need to determine what the intracranial pressure changes are inside the skull.

The intracranial pressure monitor helps researchers predict and understand SAS. They place a small monitor on the head of each astronaut. The monitor measures for increased ICP—and every astronaut's body reacts differently. The instruments will help detect which astronauts are more susceptible to ICP. Once researchers understand how SAS affects individuals, they can find different ways to treat and prevent the problem.

To test the ICP monitor on Earth, volunteers were attached to the monitor, and their information was recorded so that researchers could determine normal readings. Later, the testers spent 30 days in bed to simulate the effects of near-weightlessness on the body. Their ICPs were monitored again, and researchers compared the information.

"Using ultrasound will replace older technology," says Dr. Tom Yost, project manager at NASA's Langley Research Center. "We think this is a much superior way to avoid a lot of the problems that are associated with the measurement of intracranial pressure as it is now practiced in medicine. We really think the technology we've developed here is revolutionary in a sense, because it will mean that no one will ever again have to have a hole drilled in the head to measure intracranial pressure." And as the saying goes, you need that like you need another hole in the head.

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