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Health, Medicine and Biotechnology

# Non-Invasive Methods of Determining Intracranial Pressure

Methods to determine absolute and diastolic intracranial pressure

NASA Langley Research Center's portfolio of ICP measurement methods consist of the following. Monitoring ICP changes is of significant diagnostic and post-operative importance for patients with cranial injuries, pathologies or other conditions that may affect the pressure of the subarachnoidal fluid around the brain, and for patients who have undergone brain surgery. Indeed, even minor disturbances in ICP regulation can cause insidious damage to the brain. Current methods are typically cumbersome, or require invasive procedures, and/or carry side risks such as infection. Among other advantages, NASA's methods are non-invasive and allow for both short term and longer term monitoring scenarios. The use of ultra-low power ultrasonic wave intensities greatly lessens possible cumulative tissue damage.

National Aeronautics and  
Space Administration



## BENEFITS

- ➔ Non-invasive methods
- ➔ Can be used for short or long-term ICP monitoring
- ➔ Easy to take measurements

## APPLICATIONS

- ➔ Monitoring ICP
- ➔ Monitoring hemodynamics within the brain
- ➔ Monitoring blood pressure dynamics to assure adequate supply of nutrients to the brain

technology solution



## THE TECHNOLOGY

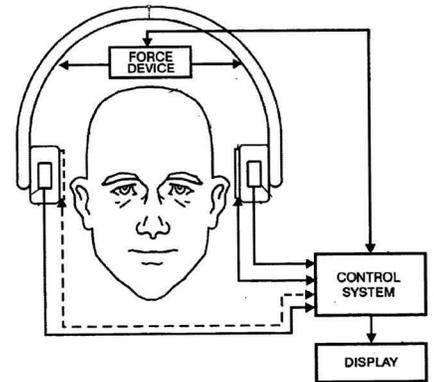
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Non-invasive method of determining absolute intracranial pressure. This method is as follows: (1) the patient's blood pressure is measured when skull expansion is approximately zero, the measured blood pressure is indicative of a reference ICP value, (2) subsequently, the method causes a known change in ICP and measures the change in skull expansion associated therewith, (3) the absolute ICP is a function of the reference ICP value, the known change in ICP and its associated change in skull expansion, and a measured change in skull expansion. US Patent 6773407.

Non-invasive method of determining diastolic intracranial pressure. This method is as follows: (1) a first change in the length of a path across the skull of the patient caused by a known change in ICP is measured and used to determine an elasticity constant for the patient, (2) next, a second change in the length of the path across the patient's skull occurring between systolic and diastolic portions of the patient's heartbeat is measured, (3) the patient's diastolic ICP is a function of the elasticity constant and the second change. US Patent 6740048.

Method and apparatus for non-invasive measurement of changes in intracranial pressure. This method is as follows: (1) first, a reference signal is generated solely related to blood pressure, (2) an information signal is generated to measure the average cranial pressure and changes due to the expansion and relaxation of blood vessels within the brain, (3) the reference signal is used to calibrate the information signal such that the pulsatile components of the information signal are only related to intracranial pressure. US Patent 6761695.

Measuring changes in ICP with ultrasonic bulk compressional surface waves. This method is as follows: (1) an ultrasonic bulk compressional wave is transmitted onto the surface of the skull that produces a surface wave, (2) by determining the retardation or advancement in phase of the received surface wave with respect to a reference phase, the circumferential expansion or contraction of the skull is used to determine the change in ICP. US Patent 6746410.



Schematic view of system to measure/monitor skull expansion.

## PUBLICATIONS

Patent No: 6,740,048; 6,746,410; 6,761,695

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