Fiber-optic sensor

A fiber-optic sensor is a sensor that uses optical fiber either as the sensing element (“intrinsic sensors”), or as a means of relaying signals from a remote sensor to the electronics that process the signals (“extrinsic sensors”). Fibers have many uses in remote sensing. Depending on the application, fiber may be used because of its small size, or because no electrical power is needed at the remote location, or because many sensors can be multiplexed along the length of a fiber by using light wavelength shift for each sensor, or by sensing the time delay as light passes along the fiber through each sensor. Time delay can be determined using a device such as an optical time-domain reflectometer and wavelength shift can be calculated using an instrument implementing optical frequency domain reflectometry.

Fiber-optic sensors are also immune to electromagnetic interference, and do not conduct electricity so they can be used in places where there is high voltage electricity or flammable material such as jet fuel. Fiber-optic sensors can be designed to withstand high temperatures as well.

Intracranial pressure (ICP) is a crucial factor that we need to take into account in all major pathophysiological changes of the brain after decompressive craniectomy (DC) and cranioplasty (CP). The purpose of a study was to check ICP values before and after cranioplasty and its relation to various parameters (imaging, demographics, time of cranioplasty, and type of graft) as well as its possible relation to postsurgical cranioplasty complications. The authors performed a prospective study in which they selected as participants adults who had undergone unilateral frontotemporoparietal DC and were planned to have cranioplasty. Intracranial pressure was measured with fiber-optic sensor in the epidural space and did not affect cranioplasty in any way.Twenty-five patients met the criteria. The mean vcICP (value change of ICP) was 1.2 mm Hg, the mean ΔICP (absolute value change of the ICP) was 2.24 mm Hg and in the majority of cases there was an increase in ICP. The authors found 3 statistically significant correlations: between gender and ΔICP, Δtime (time between DC and CP) and vcICP, and pre-ICP and ±ICP (quantitative change of the ICP).Male patients tend to develop larger changes of ICP values during CP. As the time between the 2 procedures (DC and CP) gets longer, the vcICP is decreased. However, after certain time it shows a tendency to remain around zero. Lower pre-ICP values (close to or below zero) are more possible to increase after bone flap placement. It seems that the brain tends to restore its pre-DC conditions after CP by taking near-to-normal ICP values [1)].

1)
Tsianaka E, Singh A, Drosos E, Fountas K. Direct Consequences of Cranioplasty to the Brain: Intracranial Pressure Study. J Craniofac Surg. 2021 Nov-Dec 01;32(8):2779-2783. doi: 10.1097/SCS.0000000000007945. PMID: 34727479.