Case study evaluating two positioning aids

Head immobilization during fMRI with galvanic vestibular stimulation

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Background

In neuroradiology, head movement during MRI is a significant issue. Uncooperative patients, challenging examination positions and lack of time to achieve correct patient immobilization often lead to movement artifacts. If imaging sequences contain artifacts it is more difficult to analyze the results and there is potential for misdiagnosis.

A variety of positioning aids are currently used to minimize head movement. This case study at the Ludwig Maximilian University in Munich examined the effect of using two different positioning aids on optimal head immobilization during fMRI.

Objective

In this study, the Pearltec positioning system was compared with conventional foam cushioning for head immobilization. The aids were used to immobilize the head during vestibular fMRI in order to evaluate the extent to which each aid was able to suppress head movement and to improve the analysis of the results.

Material and Methods

10 subjects underwent an fMRI scan during which they experienced galvanic vestibular stimulation (3T Siemens Verio, Erlangen, Germany; 32-channel head coil). Head immobilization was achieved using conventional foam cushioning or the Pearltec positioning system.

In galvanic vestibular stimulation, the vestibular apparatus which controls balance is artificially stimulated using an electric current so the subject perceives their head to be shaking from side to side. The subject then swiftly and reflexively attempts to counteract this sensation by moving the head inside the coil.

The results were evaluated after the procedure to assess the movement permitted in the three different planes (transverse, frontal, saggital) and the extent of cumulative positional change by the subjects during the sequences was compared for the two different positioning aids.

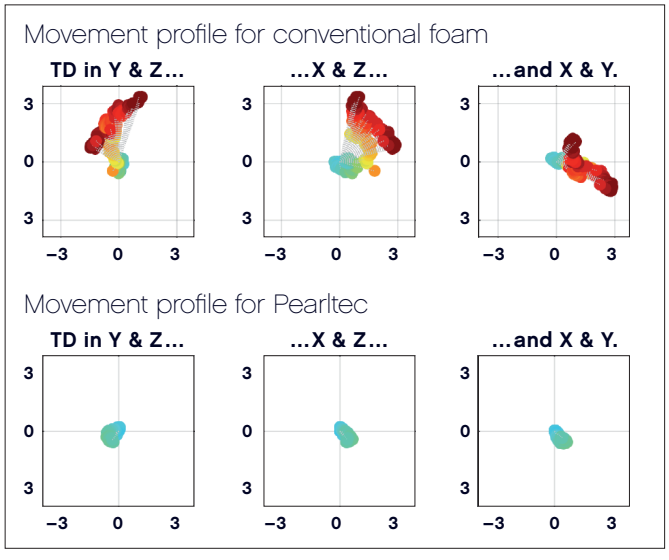

Fig. 1: Spatial resolution improved from 5.6 mm to 4.9 mm and the average positional shift from one image to the next decreased by almost 40% from 0.17 mm to 0.105 mm.

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Results

It was found that immobilization using the Pearltec positioning system resulted in significantly better image quality and improved signal exploitation. The signal-to-noise ratio increased by 20%, spatial resolution improved from 5.6 mm to 4.9 mm and the average positional shift from image to image within a sequence decreased by almost 40% from 0.17 mm to 0.105 mm.

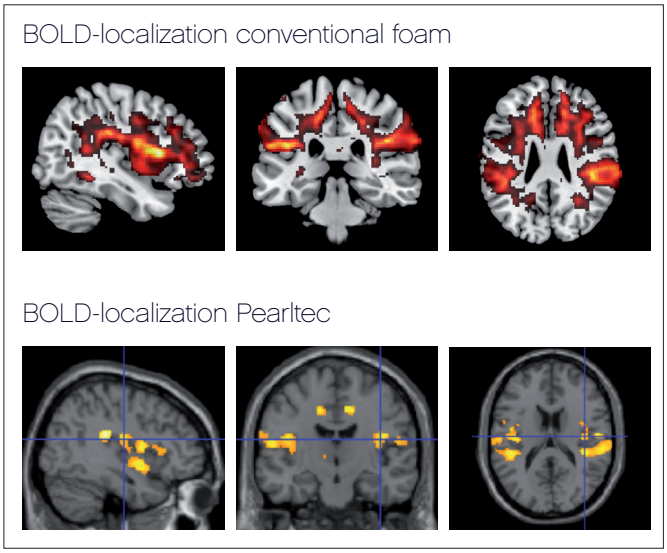

Fig. 2: More precise and significant localization of BOLD signals in the cerebral cortex during fMRI investigation using the Pearltec positioning system to immobilize the head.

Conclusion

With the Pearltec positioning system, the dominant movement could be almost fully suppressed in the three planes, which led to an improvement in image quality and better resolution in the measurement of brain activity. In particular, artifacts induced by movement responses to artificial stimulation could be suppressed, which significantly improved the fMRI signal.

About Pearltec Positioning System

The patented technology was originally developed in order to create a positional aid for high-resolution pQCT systems for rheumatoid arthritis patients and stands out primarily due to its high level of flexibility, evenly distributed pressure and adaptive immobilization. It was developed in collaboration with the Zurich Federal Institute of Technology (ETH).
The technology, which is available in a variety of product versions, reliably suppresses movement, is easy to clean and provides a high level of patient safety and comfort.