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A novel method for visual cortical prosthesis

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***Introduction**:* Visual cortex stimulation is a cutting-edge technique in neuroscience that targets the primary visual cortex (V1) to modulate visual processing. It utilizes various forms of electrical stimulation which has attracted attention for its potential to restore visual perception in blind patients, regardless of the underlying cause, and possibilities for enhancing and augmenting visual processing in individuals with intact vision. The devices are designed to bypass damaged visual pathways by directly stimulating the brain's visual processing areas and reactivate neural circuits, induce artificial visual experiences, promote neuroplasticity, and assist in rehabilitating individuals who have lost their sight due to impaired visual pathways while retaining their brain's capacity to process visual information. In the past decade, interest in developing cortical stimulation prostheses has surged, largely driven by developments in cortical stimulation waveform design [1,2] that have been demonstrated in humans and primates, brain command connectivity [3], advanced visual mapping techniques [4,5] and the apparent shortcomings of retinal prostheses in offering a comprehensive solution. Projects such as the Orion and Chicago ICVP systems that cover a limited central field of view with low resolution utilizing penetrating or surface epicortical electrodes have advanced to the point of clinical research.

Material, Methods, and Results: While still in the experimental phases, the CortiSight technology adopted recent advances in neurotechnology, high capacitance electrode design, application of AI-based algorithms for image-brain-computer interfaces, and advanced electrode arrays deployment surgical techniques, and not only aims to provide basic visual sensations but also aspires to facilitate chronic complexed functional vision experiences for individuals with blindness and deepen our understanding of brain function and sensory restoration. The device uses wide multiple electrode arrays embedded within flexible intra-cortical threads to enable an extensive and effective number of cortical neurostimulation signals. The four electrode arrays aim to cover a large visual field on both hemispheres. The 386 distinct electrodes controlled by a single implant case can be used for both active stimulation and local return to localize the affected Phosphene. The electrodes are coated with non-faradic TiN highly porosive deposition, which allows for safe, long-lasting stimulation with minimal gliosis. The implant is wirelessly linked to a headset unit to receive power and stimulation instructions. The headset uses a camera to capture images of visual scenes and provide stimulation directions that consider the patient's gaze direction as well as audio commands for zooming and brightness adjustments. The optimal wide spatial distribution of electrode arrays is achieved using a rigid *comb-like* delivery tool. The accurate and robust delivery of the tool in close proximity to the target cortical cell layer was demonstrated in a sheep model following a 3x3cm craniotomy. Lateral introduction aimed to cover the foveal visual region, while the medial introduction was applied along the calcarine sulcus to enable the activation of para-foveal visual regions (fig. 1). This approach minimizes the risk of accidentally interacting with the superior sagittal sinus vein.

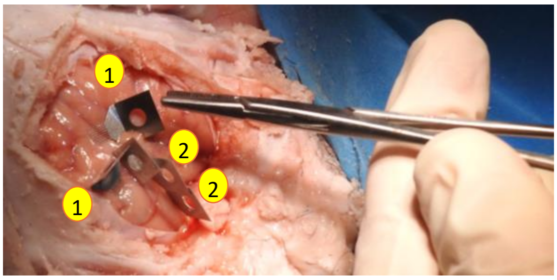

Figure 1: *A sheep brain with several orientations of the comb-like introduction tool: 1. Lateral cortex surfaces; 2. Medial cortex surfaces.*

Conclusion: A unique method of visual cortical prosthesis that may allow significant spatio-temporal resolution to blind patients has been developed and an early demonstration was performed.

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