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Electrodes in Human Eyes: An Update of Blind Patient Psychophysical Testing for Artificial Sight

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Experiments were conducted to measure the accuracy with which subjects implanted with an Intraocular Retinal Prosthesis (IRP) can perform visual tasks. The Food and Drug Administration and the Institutional Review Board of the University of Southern California approved the protocol. Test subjects who met the protocol requirements were implanted with an epiretinal prosthesis consisting of 16 electrodes in a 4x4 distribution. The tests were divided in two categories: computer controlled tests and video camera tests. Results from computer controlled tests include: sequential activation (4 alternative forced choice (AFC)) 70% correct ($p < .001$); orientation of lines of electrodes (2 AFC) 78% correct ($p < .01$). The patients also could recognize the direction of movements of a white bar in 59% ($p < .01$) in camera controlled tests. Comparing one vs. multi-pixel resolution, subjects required less time to provide a correct answer when multiple pixels were used (counting objects 27s, $p < .0001$; L orientation 80s, $p < .0003$) and a trend towards better performance when using multiple pixels (the number of pixels varied between subjects). In summary, test subjects with no better than light perception vision can perform simple visual tasks using the Model-1 IRP device. An increased number of pixels and electrodes in the Model 2 IRP device may produce greater functionality.

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