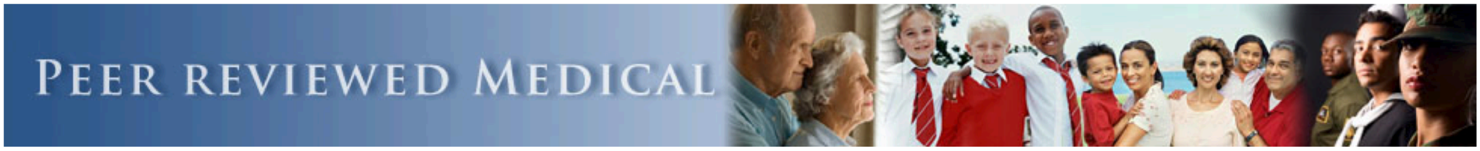

2011 Peer Reviewed Medical Research Highlights

Web-based Visual Field Assessment and Diagnosis

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Wolfgang Fink, Ph.D., California Institute of Technology, Pasadena, California

Vision is the primary sense used by most people in daily life. A variety of diseases or conditions, such as glaucoma and macular degeneration, if undetected, left untreated, or detected too late may lead to irreversible visual field loss and eventual blindness. As critical as having an unrestricted visual field is to most people, it is essential for those individuals involved in military operations in theater. In addition to diseases and disorders that may cause visual field loss, trauma, either ocular or to the brain, may also cause critical visual impairments

There are a number of different ways currently used to assess the visual field of individual eyes. Whether it is manually by a clinician, through the use of visual field mapping tools such as the Amsler grid, or by other automated systems that map and calculate the visual field, these methods require fixating the examined eye straight forward and evaluating the extent of peripheral vision. However, most of the currently available automated visual field assessment equipment has limited sensitivity. In addition, these machines are bulky and not portable, limiting their use in geographically remote areas and/or military operational settings. Previously, Dr. Fink and his colleagues developed a technology that utilizes touch-sensitive display technology, called three-dimensional computer-automated threshold Amsler grid (3D-CTAG), with an increased sensitivity of visual field assessment and an improved ability to identify visual field defects that are often difficult to discern with traditional testing methods. Using the 3D-CTAG is fast and easy; the data necessary to make a diagnosis is obtained through non-invasive means and is of high spatial accuracy. In addition, the 3D-CTAG has been successfully evaluated in clinical studies to comprehensively test the visual field of individuals with conditions such as glaucoma, ocular hypertension, age-related macular degeneration, and optic neuritis. However, data obtained through the 3D-CTAG must be manually analyzed and interpreted before the clinician can make a diagnosis. One more drawback for remote settings is that clinical expertise may not be readily available to analyze and interpret these data. In military operational settings, a clinician may not be available to make necessary split-second decisions; in such situations, accurate automated data analysis would be beneficial.

Dr. Fink received a Fiscal Year 2008 Peer Reviewed Medical Research Program Advanced Technology/ Therapeutic Development Award to use his previously developed 3D-CTAG technology as a starting point and to develop an advanced web-based system that will not only test the visual field, but will rapidly analyze, characterize, store, and share the test data to aid in the diagnosis of visual field defects.

The newly developed advanced system incorporates the 3D-CTAG, touch-screen technology, integrated analyses capabilities, and a database to assess visual performance and to analyze, interpret, and store the visual field data. To accurately analyze the 3D-CTAG-generated visual field data, Dr. Fink and his colleagues devised, implemented, and integrated a suite of numerical methods that (1) remove unwanted artifacts present in the 3D-CTAG raw data, (2) assess the visual field as a whole (i.e., visual field data transforms), and (3) characterize individual scotomas, i.e., visual field defects, within the examined visual field (i.e., scotoma data transforms).

This advanced visual field test and diagnosis system is easy to use. First, the system is calibrated by the user before assessing an individual's visual field. After calibration, the subject is kept fixed in position with a head-chin rest, with the non-test eye covered, in front of a touch-sensitive computer screen displaying an Amsler grid at a particular contrast. The subject traces on the screen with a finger the areas of the Amsler grid that are missing from the field of vision of the test eye. This procedure is repeated for varying contrast levels of the Amsler grid. Results are recorded in a database, processed, and analyzed. Following each eye's assessment, a graphical representation of the entire tested visual field, illustrating the location, extent, grade, and shape of existing visual field defects within, is automatically generated and displayed on the screen along with other critical data analysis information in alphanumerical form. A major benefit of this advanced system is that visual field defects may be assessed in the absence of a clinical expert: a significant advantage for individuals in remote areas and a critical advantage for individuals in military operational settings where it might allow for the timely application of counter measures to ensure the health and safety of personnel. Moreover, this system might assist a clinician's assessment through corroborating or contradicting a diagnosis. The next steps for Dr. Fink and his team are to further refine the system and to continue to evaluate its performance in clinical studies.

Dr. Fink's advanced visual field test and diagnosis system offers a new perspective for evaluating visual fields that includes computer-assisted diagnosis and telemedicine opportunities for individuals in geographically remote areas and/or military operational settings.

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