

Frequency Doubling Technology

Frequency doubling technology (FDT) has recently shown promise in distinguishing glaucoma patients from normal subjects (Johnson CA, Samuels SJ. Screening for glaucomatous visual field loss with frequency-doubling perimetry. Invest Ophthalmol Vis Sci 1997; 38:413-425, Quigley HA. Identification of glaucomatous visual field abnormality with the screening protocol of frequency-doubling perimetry. AM J Ophthalmol 1998; 125:819-829, Kelly DH. Frequency doubling in visual response. J Opt Soc AM 1996;56:1628-1633, and Maddess T, Henry GH. Performance of nonlinear visual units in ocular hypertension and glaucoma. Clin Vis Sci 1992; 7:371-383.) It is based on the principle that glaucoma selectively damages a subset of retinal ganglion cells (the magnocellular (M-cell) pathway). These ganglion cells have large diameter nerve fibers and comprise only 3% to 5% of all retinal ganglion cells. The damage of these cells in the disease process makes FDT efficient and effective for the detection of early visual field loss.

The test is based on the theory that when a low spatial frequency sinusoidal grating (<1cyc/deg) undergoes high temporal frequency counterphase flicker at 15 Hz or above (i.e., there is a rapid contrast reversal in which the light bars become dark and vice versa), the grating appears to be twice its actual spatial frequency.

The Screening C-20 takes only 43 seconds per eye.

Operating Procedures

- Remove the calibration cap from the subject's eyepiece.
- Select RUN PATIENT TESTS from the FDT MAIN MENU
- Enter the subject's age.
 - a. Top Blue button increases the age by 10 year increments
 - b. Bottom blue button decreases the age by 10 year increments
 - c. The third blue button increases the age by one year increments
 - d. Select ACCEPT SETTING when the correct age is displayed
- Slide the Patient Visor to the right eye test position
- Place the Response Button in the subject's hand and show her how to press it
- Ask the subject to place her forehead on the Forehead Rest and look into the eyepiece at the video screen
- Adjust the height of the chair or table to obtain a comfortable position
- Confirm the subject can see the entire lit video screen, including all four corners, in the eyepiece and black dot in the middle of the screen
- The test can be taken with correction.

At this time you will explain the test procedure to the subject: "A demo is running now. Can you see the black dot in the center and the entire lit video screen? You need to stare at the black dot in the center of the screen during the entire test."

“From time to time, you will see patterns of flickering black and white vertical bars that will briefly appear in different areas of the screen. The patterns will sometimes be very faint and at other times be very distinct. You are not expected to see the bar patterns at all times. Each time you see the flickering black and white vertical bars of one of the patterns, press the response button once. Can you see the patterns in the demonstration running now? You may practice now by pressing the Button to respond to the patterns.”

“It is okay to blink and a good time to blink is when you press the response button. If you need to rest or ask questions during the test, you can pause the test at any time by pressing and holding down the response button. Do you have any questions? Do you understand how to take the test?”

“I will now start the test. There will be a few brief flashes and then the test will begin. Press the response button once each time you see the flickering black and white vertical bars of one of the patterns, even if the bars are very faint. Please remember to stare at the black dot in the center of the screen during the entire test.”

- Select RUN SCREENING C-20 TEST from the right eye test menu
- At the end of the right eye test, the operator will prompt for a left eye test
- Slide the visor to the left eye test position
- Select RUN SCREENING C-20 TEST from the left eye menu

Printing Test Results

At the end of the test, the results will be automatically printed and the test menu will automatically appear on the Operator LCD Display. Select PRINT REPORT to obtain an additional copy of the results that will be sent to Margarita Gonzalez at the UCLA Coordinating Center. Please write the subject's ID number on the paper report. Please send the reports via Fed-ex, Airborne or any other express carrier (2nd day service) twice a month.

Understanding the C-20 Test Results

A plot of 17 visual field locations tested will be printed for each eye tested. Each test location will be either clear white or have will have one of three possible levels of shading. If the test results are clear white the test is within normal limits. If the test results have any shading the subject should be referred to an eye doctor. (Attached are copies of normal and abnormal test printout)

Fixation errors are the number of times the subject responded to a target placed in her blind spot versus the total number of fixation tested. Three fixation catch trials will be randomly presented for each eye. Fixation errors indicate the subject is not maintaining good fixation during the test, is misaligned, or does not understand the test.

False positive errors are the number of times the subject responded to a “pause” in the testing sequence (i.e., no target presented) versus the total number of “pauses” in the testing sequence. Three false positive catch trials will be randomly presented for each eye. False positive errors indicate the subject is pressing the button even if she doesn’t see any patterns or does not understand the test.