
Developments in ENG Technology

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Many years ago, I learned how to perform ENG on a strip-chart recorder. The ENG lab I worked for switched to a PC-based ENG system in 1985 and since that time I've done five hundred or more ENG tests per year. I've always thought the change from strip-chart to computer-based recording was a quantum leap in convenience, test flexibility and recording quality.

Over the years, I became very comfortable using EOG electrode recordings. When the university vestibular lab I worked for purchased one of the earliest infrared video-ENG systems for research use, I was not very impressed. The system was very cumbersome, the goggles were so heavy that their weight had to be supported by a spring assembly, the field of view through the goggles was very limited, we had to switch to a second pair of goggles for the vision denied ("eyes-closed" tests), and calibration alone consumed 15 to 30 minutes. I also had some concerns about video's lower sampling rate as

compared to electrode-based ENG. It was definitely not the quantum leap that I experienced in the change from strip-chart to computer-based electrode ENG.

As the years passed, several vendors brought improved video ENG systems to market. I dutifully reviewed the systems at conferences and when visiting other balance centers, but none seemed to offer a huge advantage over the electrode-based system I had used for years. I held off on buying video ENG technology, preferring to stick with my beloved electrodes until video technology had developed to the point that it would provide another quantum leap.

When given the opportunity to build my own balance center, I again picked computer-based ENG and rotary chair systems by choosing those that I thought had the best software and EOG amplifiers. As our program grew, video technology made it's way into the lab. Our physical therapists lobbied for a pair of video-Frenzel goggles with VCR and monitor so that they

could record nystagmus during Dix-Hallpike testing and particle repositioning maneuvers. We were very pleased with the ability to record and play back the eye movements. The video recordings added a new dimension to vestibular rehabilitation treatment and to patient education. Recordings also made it possible for the therapists to review with me any unusual eye movements they may come across, without having to make the patient go through the provocative motions all over again.

A few years ago, I was asked to participate in a pre-release beta-test of a new video-ENG (VNG) system. At the end of that beta-test period, I realized that the resulting system was a quantum leap over electrode ENG. The goggles were light enough that patients didn't complain of headache halfway through the test and there was no need to switch from one pair of goggles to another when changing from vision-allowed to vision-denied tests. The field of view was excellent, the

recordings were incredibly clean, and in our comparison tests the difference in sampling rate between video and electrode recordings produced no significant difference in the ocular motility test results.

When these products became commercially available, we upgraded both of our ENG rooms to combined ENG/VNG systems. We now use video recordings on the vast majority of our patients (77%). Electrode recordings do give us better results in a small number of patients (those with pupils partially obscured by ptosis, and those who cannot keep their eyes open in the dark), so we are quite happy with the ability to choose. Once in a while we'll even switch from one technology to the other mid-test, usually when a patient who initially gave very good recordings with video becomes drowsy and the eyelids start to droop.

To duplicate our positive experience with the video Frenzels, we spent several thousand dollars on a VCR and quad monitor for each of our two VNG systems, so that we could video tape the signals from the goggles' cameras. This has worked very well for us, but definitely has some disadvantages. The monitor and VCR take up a lot of space in the test rooms, we have to keep a drawer full of videotapes, we have to document which tape was used for which patient, and we have to remember to press the darn

record button at the start of the test. When I review a tape it is sometimes difficult to tell where we are in the test (what specific subtest is being done) when an eye movement pattern appears.

Recently, I was asked to beta test a new version of the VNG software. The new version allows the user to record and save digital 'video clips' of the actual eye movements directly to the computer's hard drive, with no special video recording equipment required. The new software works extremely well, providing high-quality recordings of the actual eye motion without the space requirements, cost and complexity of a VCR and quad-monitor setup. The video clips software records up to 40 seconds of eye movement at the press of a key or footswitch. This allows the examiner to record any unusual or unexpected eye movements seen during any of the VNG subtests, and is a great way to record the eye movement response to the Dix-Hallpike maneuver.

In our center, the balance testing battery, including VNG, is performed by technicians. I analyze and interpret the collected data and write a report to the referring physician. During the first half of the battery, the technicians fill out a form with the patient asking many medical history and vertigo symptom questions (a very good way to keep the patient alert during rotary chair and VNG testing by

the way), so that I can summarize the history in our test report. All of our test equipment (VNG/ENG, Rotary Chair, VAT, Posturography) is connected to our office network, so that I can analyze the data as the test battery proceeds. The software allows me to review and analyze each subtest of the VNG battery as soon as it has been completed, while the technician and patient proceed on to the next subtest. In most cases, I have the data analysis finished and the majority of the report written before the last caloric irrigation has been performed. After that last caloric test is finished, I come in and talk with the patient. We go over some of the details of the history, and I counsel the patient as to the test results and what our recommendations to the referring physician will be.

As part of the data analysis I routinely review the eye movement recordings of all Dix-Hallpike tests where the patient reported symptoms, looking for torsional nystagmus. This previously required that I wait until the VNG test battery was completely finished, then make the patient wait for their counseling session while I get the videotape from the test room, bring it into my office and search through the tape looking for the Dix-Hallpike test. With the new CHARTR VNG software with video-clips, as soon as the Dix-Hallpike recording is completed the actual eye movement video

is available at my desktop immediately over our office network.

Reviewing the eye movement video with the patient can be a very helpful tool in BPPV education. The video clip screen contains the patient's name and the name of the test performed, which provides a much more professional look than the VCR method. A VCR and television monitor is not needed; I can simply show the video clip on the PC screen.

I like to use eye movement videos as examples when I give talks at meetings and conferences. When I want to place a video clip into a slide show for a talk, I no longer have to connect a VCR to my computer and convert the video to a digital format. I can simply export it from the software. The exported video files can also easily be sent to colleagues on disk, by e-mail or other Internet transfer in order to obtain an opinion. My previous method was to wire together 2 VCRs, duplicate the original videotape and mail it off.

I've found that the ability to digitally record eye movements during VNG testing represents another quantum leap in both convenience and recording quality over electrode-based ENG.

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Readers can find out more about these technologies by calling 1-800-289-2150 and requesting information or they can visit ICS' website at www.icsmedical.com.