

Letter to the Editor

Incorporation of fixation-removal with Fresnel glasses in a routine EEG protocol



International EEG guidelines recommend that certain provocative maneuvers or interventions be conducted as part of routine EEGs in adults and children, in order to increase the likelihood of observing abnormalities (Sinha et al., 2016). One provocative maneuver that is rarely performed, but is recognized to elicit abnormalities, is removal of visual fixation (Seneviratne et al., 2017). The appearance of epileptiform abnormalities on removal of visual fixation and central vision is known as fixation-off sensitivity. This phenomenon is most commonly associated with genetic generalized epilepsy and self-limited childhood-onset occipital epilepsy (Koutroumanidis et al., 2009).

Rather than testing true fixation-removal, routine EEG protocols use forced or voluntary eye closure as surrogate tests. However, this approach is sub-optimal because it also results in a change in light perception which may involve a partial red filter (depending on the ambient lighting) and thus applies a more complicated set of stimuli to the brain. One option that allows for isolated removal of fixation is application of Frenzel goggles. These magnified glasses are used in vertigo assessment, removing fixation by essentially creating a very blurry visual field. These are not routinely incorporated in EEG testing, primarily because they are expensive, require batteries, and are awkward and time-consuming to apply to a patient. Here, we report the results of a study investigating whether isolated fixation-removal could be incorporated into a routine pediatric EEG protocol using Fresnel glasses, a lightweight, inexpensive and easily portable Frenzel goggle analog that resembles normal eyeglasses (Strupp et al., 2014).

We incorporated fixation-removal with Fresnel glasses into 250 consecutive pediatric routine EEG studies for patients meeting pre-determined inclusion criteria. We included all non-comatose children between 2 and 18 years of age referred for routine video EEGs at the Montreal Children's Hospital neurophysiology laboratory. Fresnel glasses were applied to each patient for 15 seconds during wakefulness; if an abnormality was seen, technicians were asked to repeat the application for an additional 15 seconds. All studies were reviewed by certified electroencephalographers. For each study, we evaluated whether application of the glasses elicited (1) change in EEG background, (2) an abnormality that would not otherwise have been identified, or (3) seizure. We also recorded situations in which the patient became distressed by wearing the glasses.

Following the study, technicians completed an anonymous survey regarding their experiences with use of the Fresnel glasses. The survey asked two yes-or-no questions – (1) Did implementing the Fresnel glasses protocol significantly complicate the exercise of performing an EEG? and (2) Do you think implementing the

Fresnel glasses improves the quality of EEG study? The survey also included a text box in which comments could be written. Informed consent was obtained verbally from all participants/parents and the study was approved by the McGill University Health Centre Research Ethics Board.

All patients tolerated Fresnel glasses well, with no reported instances of unusual patient distress. From technician surveys, all five surveyed technicians responded “No” to question (1) (“Did implementing the Fresnel glasses significantly complicate the exercise of performing an EEG?”), and “Yes” to question (2) (“Do you think implementing the Fresnel glasses improves the quality of EEG study?”).

The EEG changes observed while wearing Fresnel glasses in 250 EEGs were as follows. The most common response was no clear change in background activity, seen in 177 patients (70.8%). In 67 patients (26.8%), the normal posterior dominant rhythm, usually provoked by eye-closure, was observed. Fresnel glasses elicited abnormalities in six patients (2.4%). In four (1.6%), theta slow waves were elicited over the occipital/central regions; in one of these four, the abnormality was seen only during application of the glasses. In the other two patients, epileptiform abnormalities were seen with and without glasses; however, in one patient the abnormality appeared more clearly (described below).

The EEG diagnoses of the sample included were as follows: 163 (65.5%) EEGs were normal, 49 (19.8%) showed generalized epileptiform abnormalities, 25 (10.2%) EEGs showed focal epileptiform abnormalities, and 13 (5.1%) EEGs showed other abnormalities including mixed focal and generalized epileptiform abnormalities, and focal or generalized slowing. Of the 87 abnormal EEGs, one EEG showed abnormality only during application of the glasses (0.4%) and in another a subtle abnormality was clarified, as described in the illustrative case below.

In one patient, application of Fresnel glasses clearly impacted clinical management. This 7-year-old boy was referred with a history of two paroxysmal events involving 5 minutes of blank staring, sweating and confusion. He did not show the classic electrographic findings of a self-limited occipital epilepsy of childhood (focal epileptiform discharges over the occipital regions) until application of Fresnel glasses (Fig. 1).

EEG is the most common neurophysiologic test performed in children. The yield of the interictal EEG in various published studies ranges between 29–55 % (Pillai and Sperling, 2006). This relatively low yield has prompted efforts to look for additional means that increase EEG clinical utility by including routine provocative measures into the daily EEG practice. The current well-established measures include intermittent photic stimulation, hyperventilation and sleep deprivation.

In this study we were able to easily integrate Fresnel glasses into our routine EEG protocol, which already included voluntary or forced eye closure. We found that Fresnel glasses are a simple,

well-tolerated procedure that may provide additional, clinically useful data from an EEG without adding undue time or patient discomfort to the testing protocol. For at least one patient, the response to Fresnel glasses affected clinical management. Although application of the glasses is not difficult, the full clinical

utility might become more apparent once technicians become more familiar with the glasses and skilled at using them to completely obscure the patient's visual field.

Given these findings, we propose that other laboratories consider incorporating fixation removal using Fresnel glasses or other

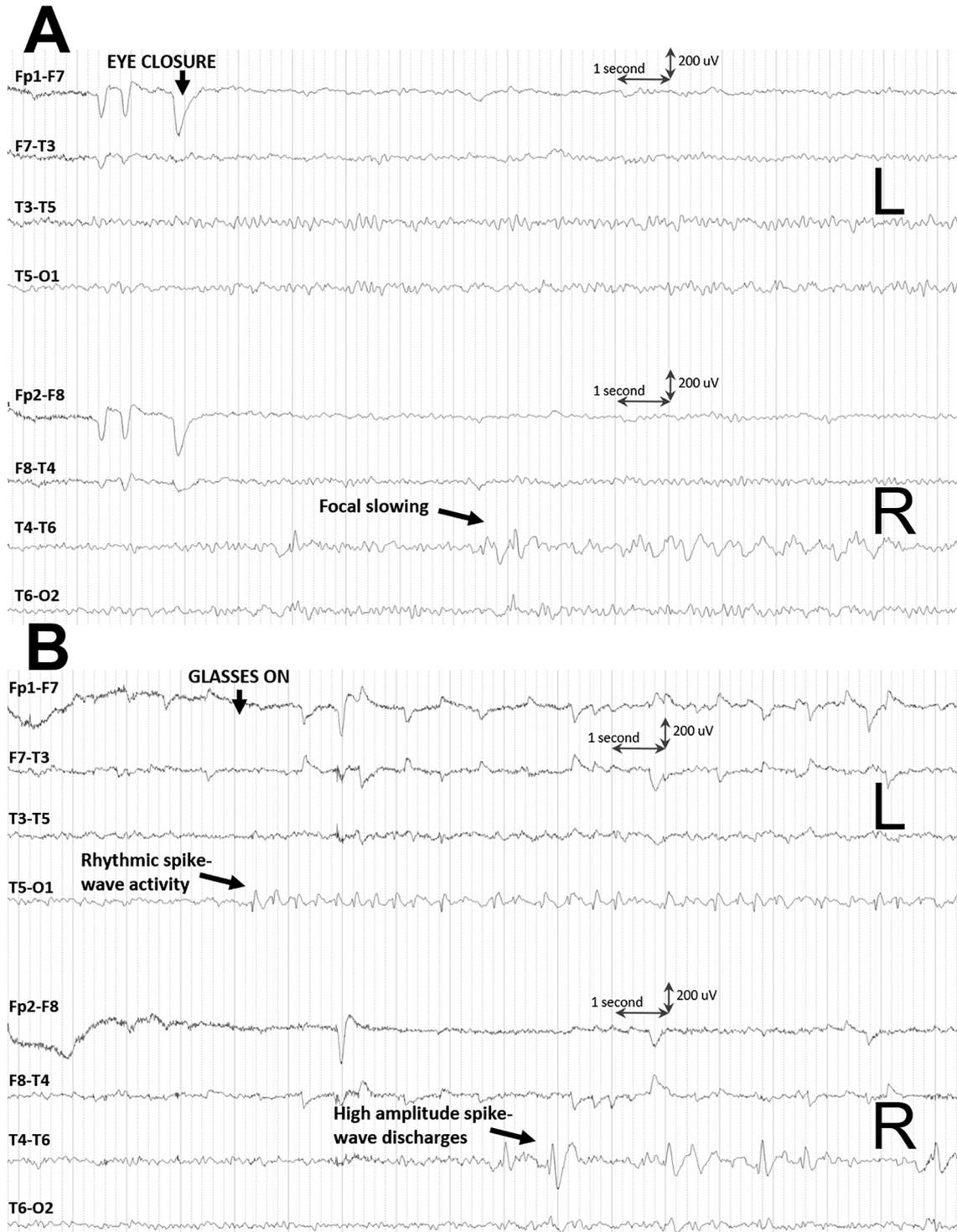


Fig. 1. The EEG of a 7-year-old boy with history of two paroxysmal events involving blank staring, sweating and confusion, each lasting an estimated five minutes. With eye closure (A), there is little immediate change to the background, with only occasional focal sharp waves and focal slowing developing over the right posterior temporal six seconds after eye closure. With application of Fresnel glasses (B), there is immediate rhythmic spike-wave activity seen over the left occipital region and some higher amplitude spike-wave and focal slowing over the right posterior temporal region. The pattern is most consistent with a self-limited occipital epilepsy of childhood (i.e. Panayiotopoulos syndrome or Gastaut syndrome). Longitudinal bipolar montage was used, with high frequency filter 70 Hz, low frequency filter 1.6 Hz, and time base 20 s/page.

similar device into all routine EEG studies. Reasonable exceptions would be blind patients, very young babies in whom visual pathways are not yet well-developed, and profoundly comatose patients.

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Conflict of Interest Statement

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