I. Introduction

ERG responses to flash and step stimuli include high-frequency oscillations (oscillatory potentials, OPs) that can be isolated with a bandpass filter of 75-300 Hz. ERG responses to pattern stimuli (pERG), generated with progressive scan displays (e.g., CRT, LCD monitors that update line-by-line from top to bottom over approximately 10 ms), do not typically contain OPs, regardless of the recording amplifier passband. Pattern ERG responses recorded with a synchronously updated display (all checks reverse at the same time) do contain high-frequency oscillations well isolated with a bandpass filter of 50-300 Hz [Patanay et al., 2018]. This study evaluates the effect of progressive-scan displays on the recorded response waveform for pattern stimulus ERG.

II. Methods

Synchronous pERG

A. Synchronous pERG response waveform. The average pERG response waveform recorded from six healthy subjects with a 50 Hz frequency oscillation. The response exhibits high- and low-frequency components; these components were isolated using fourth-order zero-phase Butterworth filters, with pass-bands of 1-50 and 30-500 Hz. B. Isolated low-frequency pERG components (3-50 Hz). C. Isolated high-frequency pERG components (50-300 Hz). D. Average pERG response from the asynchronous (black, 1-100 Hz) and progressive-scan (green, 50-300 Hz) displays.

III. Results

Simulating the response to a pattern reversal from a progressive-scan display.

This study evaluates the effect of progressive-scan displays on the recorded response waveform for pattern stimulus ERG.

IV. Summary

1. The high-frequency oscillations, which are prominent in synchronous display pERG waveforms, are absent in the normal and simulated progressive-scan pERG waveforms.
2. Filtering synchronous display waveforms with progressively narrower passbands until they matched the progressive-scan waveforms demonstrates that the progressive presentation of the pattern reversal to the retina over a 10 ms period has an effect equivalent to applying a 70 Hz low-pass filter.
3. Progressive-scan displays with refresh rates of 100 Hz or less preclude the direct recording of high-frequency (significant energy above 70 Hz) response components in the pERG.
4. High-frequency response components in the pERG waveform are only directly observable with the use of synchronous display stimuli.
5. Response waveforms from progressive-scan displays are shifted in time, from the time pattern reversal begins, by an amount equal to one half of the refresh time (5 ms for a 100 Hz refresh rate).
6. Time shifting progressive-scan pERG waveforms adds a value to pERG implicit times that is not related to retinal physiology; this value may vary by system, and thus complicates analysis of pERG implicit times between systems.