Waveform characteristics in congenital nystagmus

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Abstract. Using infra-red oculography, electro-oculography and fundus video-recordings, waveform characteristics (amplitude, frequency, waveform shape and foveation) were examined in over 150 individuals with congenital nystagmus. For many of the subjects the nystagmus exhibited marked variability in both space and time. The sources of this variability were explored and the state of attention of the observer was found to be a dominant factor. The waveform and precision of foveation were not found to be related to any one classification group (eg. albino or idiopathic).

Introduction

In recent years, with the advent of accurate eye movement recording systems, the ocular motor characteristics of congenital nystagmus (CN) have been examined in a far more quantitative manner than was previously possible (Dell'Osso, 1982; 1984; Van Vliet, 1982; Gresty et al., 1984; Collewijn et al., 1985).

Although the involuntary oscillations are noticeably heterogeneous, certain distinguishing features are observable. The nystagmus is invariably bilateral, conjugate and predominantly horizontal (uniplanar) although small torsional movements about the sagittal axis are not uncommon. On the other hand, a wide range of amplitudes and frequencies of the nystagmus are encountered within the population, whilst at least twelve distinct waveforms have been described (Dell'Osso and Daroff, 1975). Moreover many factors such as fixation attempt and gaze position can have considerable effects on the nystagmus intensity (amplitude x frequency) and waveform; spontaneous changes can also occur. To the clinician, where time is of the essence these variables can complicate the assessment of the congenital nystagmat. If the involuntary retinal image motion is, at least in part, responsible for the lowered visual acuity, which characteristic of the nystagmus – the amplitude, frequency or waveform – is the best index of visual performance?

Previous research has suggested that although the amplitude and frequency of the oscillations are important, the shape of the nystagmus waveform appears to be even more significant (Dell'Osso, 1973; Abadi and Sandikcioglu,
1974; Dell'Osso and Daroff, 1975). Each nystagmus cycle may be conveniently separated into the slow phase, taking the target away from the fovea, the slow or fast return phase and the foveation period of minimum velocity. All CN waveforms have been reported to have increasing velocity exponential slow phases taking the target away from the fovea (Dell'Osso, 1982).

There is little doubt that the involuntary retinal image motion is at least in part responsible for the poor visual acuity encountered amongst individuals with congenital nystagmus (Abadi and Sandikcioglu, 1974; Abadi and King-Smith, 1979; Dickinson and Abadi, 1985). In CN the eyes may be thought of as oscillating away from and back to the target such that one peak of the waveform corresponds to imaging the target in the foveal region. If this peak of the oscillation were flattened then there would be an increase in foveation time per cycle and a maximising of visual acuity (Dell'Osso, 1973; Abadi and Sandikcioglu, 1974; Dickinson and Abadi, 1985). Ideally in the interests of good visual acuity the fovea should coincide precisely with the flatter of the two waveform extremities. Of course implicit in this rationalisation is that the fovea is functionally operative. With an abnormal fovea one might expect that foveation time may not be as great, or foveation position not as precise.

Albinos may therefore be expected to exhibit a greater range of foveation time and position than say the idiopathic nystagmat, whilst we might anticipate that idiopaths would demonstrate identical and equally precise foveation strategies. The purpose of this study was twofold. Firstly to examine the oscillation characteristics present in CN in order to discover any trends within the subject groups and secondly to assess the foveation abilities of the albino and idiopath.

Methods

Subjects

Over 150 individuals aged between 6 weeks and 72 years of age have been examined. We have sub-divided them into a number of convenient groups (Figure 1) on the basis of any associated (though not necessarily causal) ocular anomaly.

Monitoring oscillation characteristics

Bilateral horizontal eye movements were monitored monocularly with DC electro-oculography (bandwidth 0–25 Hz) and/or with an infra-red photoelectric system (bandwidth 0–70 Hz) (Abadi et al., 1981). Both eye position and velocity were displayed by chart recorder whilst subjects were asked to fixate stationary targets in space.

Monitoring foveation

Thirteen subjects (10 idiopathic congenital nystagmats and 3 tyrosinase