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RESEARCH REPORT

CONTACT LENSES AND CONGENITAL NYSTAGMUS

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Abstract—The use of contact lenses has been reported to result in increased acuity and reduced nystagmus in subjects with congenital nystagmus (CN). We investigated the role of sensory feedback of lens motion via tactile sensation from the inside of the lids on the reduction of CN amplitude. The use of a topical anaesthetic to eliminate sensation resulted in increased CN amplitudes whereas, without anaesthetic, increased pressure on the outer lids reduced the nystagmus. Our data support the hypothesis that contact lenses cause increased tactile feedback from the inner eyelids that damps the CN and results in better acuity.

Key words—Contact lenses; congenital nystagmus; tactile feedback.

INTRODUCTION

Occasionally, anecdotal reports claim that, for a particular subject with congenital nystagmus (CN), the insertion of contact lenses causes a marked diminution or cessation of the oscillation, accompanied by increased acuity. We have found very little in the literature concerning the use of contact lenses to improve acuity in subjects with CN and no studies of their effects on the nystagmus itself. A report by Sédan discussed two CN patients, one of whom had albinism (1966). Abadi studied the contrast sensitivity function of a CN subject and found both improvement of acuity and damping of nystagmus with contact lenses (1979). More recently, Allen and Davies reported increased acuities with the use of contact lenses in seven of eight patients with CN (1983). Although we have never observed a dramatic change in CN amplitude when contact lenses were used, such an occurrence raises several questions with regard to the mechanisms that might be responsible. Specifically, could the decrease in CN be due to the increase in mass or friction introduced? Could it be due to tactile feedback? Could the CN decrease be secondary to the increase in acuity and concomittent decrease in visual effort resulting from the refractive correction of the contact lenses? Finally, are there waveform changes introduced by the contact lenses that might account for an increase in acuity? We undertook a study of the effects of contact lenses on the nystagmus of a CN subject. Although this subject showed no dramatic, clinically evident changes in his CN when contact lenses were inserted, we reasoned that sensitive CN records made under various conditions might reveal subtle changes common to other CN subjects that would explain the increased acuities noted above.

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MATERIALS AND METHODS

The 46 yr-old male subject of this study had CN with a null angle at 2° left gaze and a predominant waveform of pendular with foveating saccades (Dell'Osso and Daroff, 1975). His refraction (OD: +1.50 S −2.50 C ax 150, OS: +2.00 S −2.75 C ax 20) resulted in a visual acuity without correction of 20/70 OU. The best corrected visual acuity attainable with spectacles (refractive correction alone) was 20/40 OU which was increased to 20/25 OU by the addition of composite base-out prisms (OD: 11D BO and OS: 4D BO); the prisms damped the CN by shifting gaze to the null angle and inducing convergence. With soft contact lenses, his acuity was either 20/40 (partial correction) or 20/25 (full correction) OU depending on which of two pairs of lenses we inserted. The subject was binocular with conjugate movements and no manifest strabismus.

Eye movements were monitored using the infrared technique. The recordings were made on a rectilinear strip chart recorder. The total system bandwidth for both position and velocity channels was 0–100 Hz. The nystagmus was measured at gaze angles between + and $-15°$ at 5° increments.

To study the effects of tactile (eyelid) feedback we introduced several drops of a topical anaesthetic (Proparacaine HCl 0.5% ophthalmic solution) into first one and then both eyes. Under the condition when one eye was anaesthetized, measurements were made during both uniocular and binocular fixation. In addition to reducing tactile feedback with an anaesthetic, we increased it by the application of slight pressure on the eyelid; the latter was done without anaesthetic present in the eyes. The subject used a cotton swab to press lightly against the eyelid of the fixating eye without causing blurring or image displacement. He reported specific periods of clear vision which were marked on the eye-movement record.

Analysis consisted of manual measurement of the peak-to-peak amplitudes of several seconds of the CN oscillation at the gaze angles of interest. The records were analyzed by someone unfamiliar with ocular motor studies after being trained to properly make the measurements.

RESULTS

While wearing the 20/25 contact lenses and with one eye anaesthetized, measurements were made while either it was the fixating eye (the other behind cover) or vice versa. With both eyes anaesthetized, measurements were made during binocular fixation. Figure 1 contains graphs of the peak-to-peak CN amplitudes at various gaze angles. The dashed portions of Fig. 1 (and Figs 2 and 3) indicate that, since this subject's null was previously determined to be at 2° left gaze, the CN amplitude there would have been at least as small as that measured at the lowest point in our paradigm.

When both eyes were anaesthetized, measurements were made without lenses (20/70 acuity) and with the better pair of contact lenses inserted (20/25 acuity). Figure 2 compares the CN of this subject when both eyes were anaesthetized and either no lenses or the 20/25 lenses were inserted.

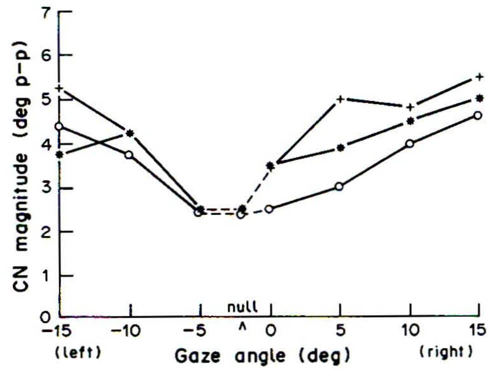

Fig. 1. Plots of CN amplitude vs gaze angle while wearing the 20/25 contact lenses with the right eye anaesthetized. Right eye viewing (+), left eye viewing (○) and both eyes viewing (*). "Null" indicates the position of the subject's null angle in Figs 1–3.

A pair of contact lenses that only partially corrected the subject's acuity (to 20/40) was also used without anaesthetic. Figure 3 compares the CN amplitudes recorded with these lenses to those of the better lenses (20/25) both with and without anaesthetic (OU).

Finally, Figure 4 shows a portion of the record made while the subject was lightly touching the eyelid of the fixating eye (the other was behind cover) and reporting good vision; this was done for each eye. As this figure shows, both eyes had reduced CN; the waveform was unchanged. That result was independent of which eyelid was touched. The CN amplitudes could be reduced by approximately 50% by this maneuver.

Fig. 2. Plots of CN amplitude vs gaze angle with both eyes viewing and both eyes anaesthetized. No lenses (○) and 20/25 contact lenses (*).

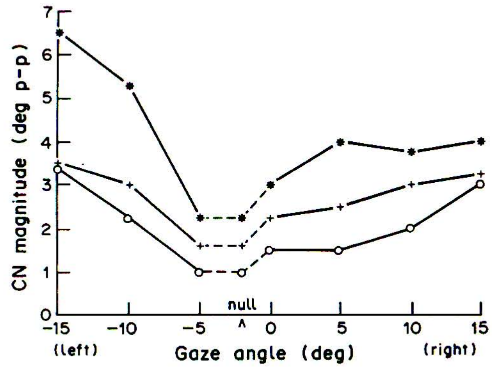

Fig. 3. Plots of CN amplitude vs gaze angle while wearing contact lenses with both eyes viewing. Both eyes anaesthetized and wearing 20/25 contact lenses (*), no anaesthesia and 20/40 contact lenses (+) and no anaesthesia and 20/25 contact lenses (○).

DISCUSSION

An obvious explanation for the diminution of the CN while wearing a contact lens would be that the increased inertial loading of the lens served to damp the oscillations on a purely mechanical basis. Considerable evidence exists that this is not the case, however. Robinson (1964) showed that a scleral search coil, used for recording eye movements, had negligible effect on saccade dynamics, even though it increased the effective moment of inertia of the eye by 126%. His analysis showed that, in general, the mass of the eye could be neglected in considering what factors affected saccadic characteristics. Since the soft lenses used in the present study were much lighter than a scleral search coil, we would expect them to have even less effect. He also found that, for saccades, the increased friction caused by the rubbing of the lens on the eyelid had negligible effect. This is also consistent with the finding by Magoon and Scott (1982) that the extraocular muscles are greatly "overdesigned" with respect to the maintenance of saccadic velocity; that is, a reduction of 50% in muscle force produced only a minimal decrement in velocity. If either mass or friction caused the damping of CN when lenses were used, the use of the anaesthetic should not have affected that damping. Our data in Fig. 3, showing an increase in CN amplitudes when anaesthetic was used, support the hypotheses that neither mass nor friction are factors.

The points shown in Figs 1–3 represent average CN amplitudes at each gaze angle. Within 5° of the subject's null, there was very little variation in amplitude (less than 1°) but at gaze angles greater than 5° from the null, greater variability was seen (up to 4°). The greatest variability exhibited by this subject was at gaze angles of 5 and 10° to the right. If a particular condition results in a significant difference in CN amplitudes, it might do so over the whole range of gaze angles. However, since CN is minimal within a few degrees of the null angle, amplitude differences there are most closely related to visual acuity and are important, given the lower amplitude variation. For this subject, the region of interest lies between primary and 5° left gaze.

With one eye anaesthetized, there was no appreciable effect on the CN amplitude caused by monocular viewing (Fig. 1). The curves cross on both sides of the null region and overlap within that region. Figure 2 demonstrates that anaesthetizing both eyes also resulted in no appreciable effect of the presence or absence of contact lenses despite the difference in acuity

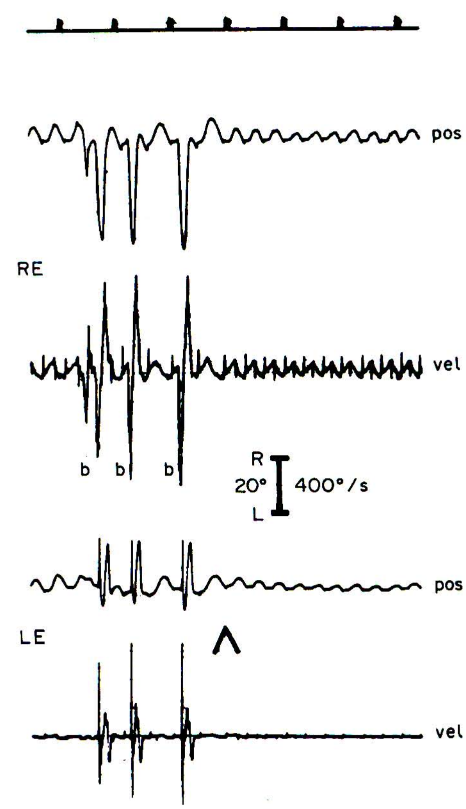

Fig. 4. Eye position (pos) and velocity (vel) records of both eyes demonstrating the effects of increased pressure on left eyelid (arrowhead). Left eye was viewing and right eye behind cover. RE—right eye, LE—left eye, R—right, L—left and b—blink. Timing marks indicate one second intervals. The vel calibration shown is for the LE; the RE vel gain was increased to show detail.

possible under the two conditions (20/70 without lenses and 20/25 with lenses). The curves again overlap and cross. The data in Fig. 3 illustrate the effect of anaesthetizing both eyes on the CN amplitudes when contact lenses were worn. There was a marked reduction (>50%) caused by the presence of the 20/25 lenses when no anaesthetic is present. Even during the trial with the 20/40 lenses, the CN was less than with the 20/25 lenses plus anaesthesia; the lack of tactile sensation caused by the anaesthesia appeared to have overridden the beneficial effects of increased acuity due to better correction.

Abadi suggested that the improvement caused by contact lenses might be due to either improved retinal images or sensory feedback of the movement of the edge of the lens from the inside of the lid (1979). Our data support the hypothesis that tactile information, possible without anaesthesia but blocked by the anaesthetic, was used by the ocular motor system to reduce the CN oscillation. The effects of further increasing such tactile signals by increasing pressure on the eyelid (shown in Fig. 4) were a 50% reduction in the CN of both the eye with increased pressure and the fellow eye (behind cover). This was independent of which eye was stimulated and is further evidence against the hypothesis of increased friction, which should have caused a reduction only in the eye subject to increased pressure. The effect of increased acuity, and lowered effort to see, is evident in Fig. 3. The CN amplitudes with the 20/40 lenses were always greater than with the 20/25 lenses; this, despite the nature of the simple, low-effort task of looking at an LED (i.e. there were no acuity-dependent discriminations required). Summarizing Figs 2 and 3, contact lenses did not reduce CN if the cornea was anaesthetized and proper refraction reduced CN only in the presence of normal sensory feedback of the contact lens motion. We did not test whether the application of a local anaesthetic could make CN worse when no contact lenses were in place.

This subject showed no waveform changes during either the experiments with anaesthetic or increased pressure. Therefore, foveation time was increased in proportion to the decrease in CN amplitude. It is possible that, in another subject, the effects of contact lenses might include a more favorable (i.e. longer foveation time per cycle) waveform.

Because the damping effect of contact lenses on CN was measurable even when not clinically apparent, contact lenses may prove to be another therapeutically useful method of reducing CN and increasing acuity. It should be noted that the subject was used to the lenses and was not consciously aware of their presence during his normal activities. Rather than a contraindication, the presence of CN should *suggest* the use of contact lenses to the clinician. Perhaps the central effect of increased tactile feedback is so great in some patients that CN will be dramatically reduced (or stopped completely) as has been noted by some. Even in cases where only a small reduction results, better acuity appears to be possible with contact lenses than with spectacles. Consistent with the existing literature, our subject's acuity was better with contact lenses than with spectacles that only corrected his refractive error; when prisms were added to the latter, the acuity was better still. Any reduction in a subject's CN should, in the absence of primary visual deficits, result in better acuity.

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