SOFT CONTACT LENSES TO IMPROVE MOTOR & SENSORY FUNCTION IN

CONGENITAL NYSTAGMUS

A CASE STUDY

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Abstract

Nystagmus is a relatively common clinical condition that remains a therapeutic enigma. We present a case in which soft contact lenses were prescribed in a young adult with congenital jerk nystagmus. Immediate and large improvements in both motor and sensory function, as well as cosmesis, were found, with enhancement one week later following constant lens wear. Use of soft contact lenses in these cases represents a simple, effective and inexpensive therapeutic option.

Key Words

contact lenses, contrast sensitivity, cosmesis, eye movements, nystagmus, proprioception, sensory function, taction, vision development, visual acuity

INTRODUCTION

Nystagmus occurs in 0.4% of the clinical population.[1,2] It is characterized by involuntary oscillatory eye movements typically having a frequency range of 2-5 Hertz (Hz) with an amplitude of 1-5 degrees. These movements are generally horizontal in direction, although they may include a small vertical or rotary component. Because the eyes of a nystagmat are in constant motion, they are not capable of foveating an object of interest for sustained periods, with resultant peak retinal-image velocity frequently exceeding 600 times that of normal fixational drift eye movements.[1] These abnormal, rhythmical eye movements are debilitating. They cause sensory deficits such as reduced contrast sensitivity, visual acuity, and stereoacuity due to chronic early abnormal visual experience related to the increased and abnormal retinal-image smearing and reduced foveation times. In addition, the presence of nystagmus can have profound psychological effects resulting from the unusual cosmetic appearance of the eyes with related social implications.[1,2]

A number of treatment options have been proposed to ameliorate nystagmus including: eye muscle surgery, oculo-motor auditory feedback, vision therapy, base out and composite prism spectacles, and soft/rigid contact lenses.[1-10] One clinical strategy has been to reduce the abnormal motor component, so that the remaining deficit is primarily sensory in nature. Both the residual sensory and motor aspects are potentially remediable by conventional vision therapy.[5]

The use of contact lenses in the clinical treatment of nystagmus has been described in the literature for 50 years. Both hard and soft contact lenses, as well as large molded scleral lenses, have been used. [3,4,8,10-13] The reasons attributed for the vision improvements with contact lenses over that found with spectacles were typically of an optical nature:

1. reduced optical aberrations
2. enlarged retinal image (in refractive myopes)
3. increased peripheral visual field.

Any or all of the above would improve the quality and/or extent of the retinal image, and hence provide a visual input of higher fidelity for fusion and subsequent visual information processing.

However, in one early clinic report, the notion of lid-based tactile feedback was advanced.[14] More recent evidence based upon objectively recorded eye movements has confirmed that lid-derived, tactile feedback plays a significant role in this phenomenon.[8,11] For example, when spectacles were replaced with hard contact lenses, both oculomotor and related sensory improvements were evident: nystagmus amplitude decreased, and both visual acuity and contrast sensitivity improved.[8] Of particular interest and surprise was the finding that even soft contact lenses produced similar oculomotor improvements in patients six to 11 years of age.[11] Such contact lens-derived proprioceptive information would appear to be minimal due to the relative comfort and lack of sensation because of the pliant nature of the lens material. Hence, this phenomenon demands further probing, as the potential clinical benefits remains largely untapped.

In the present case study, we provide further objective evidence demonstrating the efficacy of soft contact lenses in the treatment of nystagmus, thereby advancing a primary role for proprioception in the process.

CASE STUDY

Apparatus

1. Horizontal eye movements were objectively assessed binocularly at near (40 cm) using the infrared reflection technique.[1] This system has a linear range of +/-10 degrees, a resolution of at least 0.25 degrees, and a frequency response of dc to 100 Hz. The direct eye monitoring components of the system were spectacle-mounted for stability, in conjunction with a chinrest/headrest assembly. A strip chart recorder was used to document and quantify the eye movements. The stimulus, a 0.25 degree bright spot of light, was displayed on a monitor screen along the midline at 40 cm.
2. Distance visual acuity (monocular and binocular; high contrast using a projected Snellen chart and low contrast using the Bailey-Lovie Chart) was assessed.[15]

Patient

An 18-year-old female was referred from the State University of New York, State College of Optometry's Low Vision Clinic to its Cornea Contact Lens Specialty Clinic. The patient had a history of congenital jerk nystagmus secondary to ocular albinism. All other personal and family medical and ocular histories were negative, aside from the fact that the patient was using the birth control patch. She sought to be fit with contact lenses for cosmetic reasons. Her refraction and best corrected visual acuity with spectacles were: OD -4.00D -2.75D x 170 (20/120), and OS -4.00D -3.00D x 025 (20/200). She had strabismus surgery two years earlier to correct a constant esotropia. A residual 15 prism diopters of intermittent alternating esotropia at distance and near remained. We first tried to fit her with gas permeable contact lenses, but the patient found them quite uncomfortable. We then recommended a trial with soft contact lenses, and the patient agreed.

Methods

The patient was fit with Cooper Vision Preference Toric Soft Contact Lenses[a] (SCL) (trial lenses) using the least amount of minus power that optimized visual acuity. Lens parameters were: 8.7mm base curve, 14.4mm diameter, 0.09mm center thickness, OD -3.00D/-2.25Dx180, and OS -2.00D/-2.25Dx010.

Horizontal fixational eye movements of the right eye were recorded under binocular viewing conditions with the target: on the midline, 10 degrees to the left, and 10 degrees to the right, for periods of 30 seconds each. Each position was repeated once. These recordings were performed for three test conditions:

Condition A. Wearing Spectacles: This provided the habitual baseline nystagmus.

Condition B. Wearing SCL: This demonstrated the effect of the SCL on the baseline nystagmus.

Condition C. SCL with anesthetic (proparacaine hydrochloride 0.5% ophthalmic solution): This demonstrated the effect of the removal of proprioceptive information on the nystagmus with the SCL in place.

Eye movement results were averaged for each position and each condition. Blinks and other artifacts were excluded.

In addition, high and low contrast distance visual acuities were assessed under each condition using a projected Snellen acuity chart for high contrast and a Baily-Lovie chart for low contrast visual acuity.[15] One week later, following full-time soft contact lens wear, the above testing was repeated with the SCL in place.

RESULTS

The motor and sensory findings are summarized in Table 1. Eye movement recordings are presented in Figures 1 & 2.

Table1 : Sensory and Motor Findings

Test Condition	Amplitude (degrees)	Frequency (Hz)	High Contrast Visual Acuity	Low Contrast Visual Acuity
Test Session One: Spectacles (baseline)	9.00	1.25	20/120 OD 20/200 OS	- - - -
SCL	1.75	1.05	20/100 OD 20/125 OS 20/100 OU	20/125 OD unable to perform at 1 meter test OS distance 20/125 OU
SCL with anesthetic	2.70	1.40	- - - -	- - - -
Test Session Two: SCL one week later	0.72	1.80	20/80 OD 20/125 OS 20/80 OU	20/100 OD 20/125 OS 20/100 OU
SCL with anesthetic one week later	3.30	1.95	- - - -	- - - -

Oculomotor: Baseline fixational eye movement recordings with spectacles (condition A) revealed a mean nystagmus amplitude of 9 degrees with a frequency of 1.25 Hertz (Hz). With application of the SCL (condition B), the nystagmus amplitude was immediately and markedly reduced, and there was some reduction in frequency. With the SCL and the anesthetic (condition C), the nystagmus amplitude and frequency increased moderately when compared with condition B. See Figure 1.

After one week of full time SCL wear, the evaluation indicated that the amplitude remained small and was even further reduced as compared with the initial visit, but with a small increase in frequency. When the anesthetic was applied (condition C), the amplitude and frequency again moderately increased. See Figure 2. These oculomotor improvements were also readily apparent with gross visual observation.

Sensory: Baseline visual acuity with spectacles was 20/120 OD and 20/200 OS. Upon initial insertion of the SCL, visual acuity improved slightly with the high contrast chart. At the one week follow-up, both high and low contrast visual acuity improved even more.

DISCUSSION

The results demonstrated a consistent decrease in nystagmus intensity (i.e., amplitude x frequency) which was primarily related to the nystagmus amplitude and not its frequency. There was also an improvement in sensory function and a noticeable improvement in cosmesis with the SCL. These findings confirm and extend the earlier reports with both soft and hard contact lenses.[3, 4, 8, 9, 11-17] In addition,

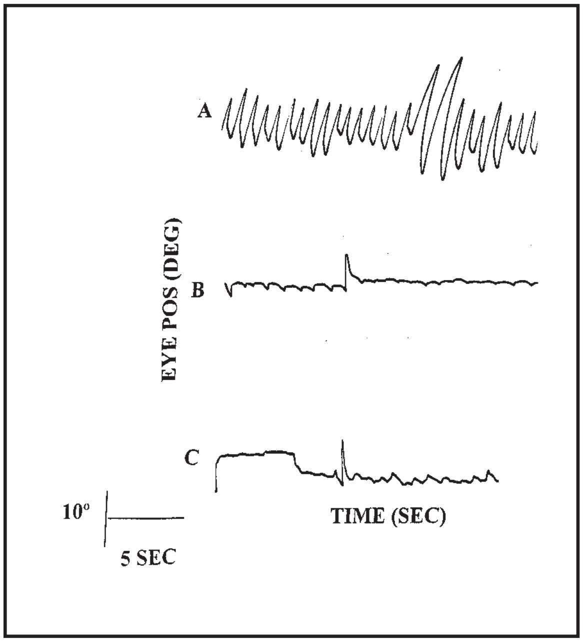

Figure 1. Figure 1: Horizontal eye position as a function of time. Initial test session. (A) with spectacles. (B) with SCL. (C) with SCL and anesthetic. Upward deflection indicates leftward nystagmoid movement, and downward deflection indicates rightward nystagmoid movement.

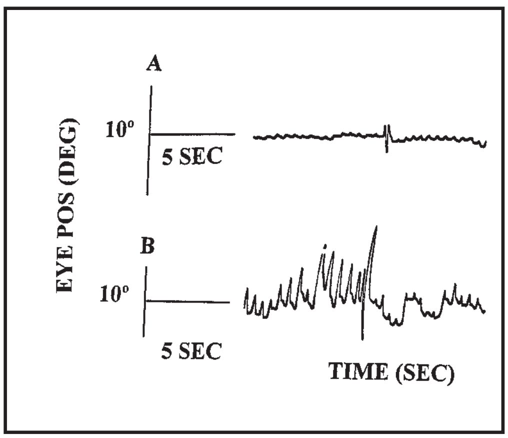

Figure 2. Horizontal eye position as a function of time. Follow-up test session, one week later. (A) with SCL. (B) with SCL and anesthetic. Upward deflection indicates leftward nystagmoid movement , and downward deflection indicates rightward nystagmoid movement.

the results are consistent with those found using oculomotor auditory feedback.[18, 19] Due to the relatively slow speed of the strip chart recorder, precise determination of foveation periods was not possible. However, under those conditions in which the amplitude markedly decreased with relative constancy of the frequency, it is a reasonable assumption that foveation times increased. This would result in improved sensory function due to reduced retinal-image motion.

These results are promising. However, there are two caveats that should be kept in mind. Firstly, there is a report of a 20-year-old female nystagmus patient who was fitted with a rigid gas permeable contact lenses for a 90 minute trial session.[16] Upon removal of the lenses, she experienced a short-term (approximately 20 minutes), rebound phenomenon that included oscillopsia and dizziness. It was postulated to have occurred secondary to a transient change and requisite readaptation of the nystagmus waveform. But this appears to be a rare event. Secondly, the motor improvement may not occur in everyone. However, improved global vision function related to the overall change in optical quality is typical.[17]

The results with anesthetic (condition C) support the hypothesis that the SCL provide proprioceptive feedback via the palpebral conjunctiva. The patient's use of this proprio- ceptive information apparently allowed her to gain immediate control of the nystagmus. This appears to represent a more general trigeminal nerve phenomenon; for example, gentle touching of the upper eyelid and the forehead have been shown to reduce nystagmus.[7,20] Further, use of a topical anesthetic to block these lid sensations has been shown to increase both the amplitude and frequency of the nystagmus complement.[11] This in turn seems to represent a more general phenomenon of afferent/somatosensory influence on the oculomotor control pathways. This influence has been reported with either vibrations to, or acupuncture on, the neck musculature.[21-23] If these same results can be demonstrated in infants and very young children, perhaps a battery powered vibrating "nystagmus collar" can be developed and worn to reduce nystagmus intensity during most waking hours. This, in turn, could help promote more normal vision development. The addition of soft contact lenses when feasible could then ensure more normal visual motor and sensory development in these children.

CONCLUSION

We have presented the short-term positive effects of the use of SCL in the treatment of nystagmus. Further research is needed to investigate the efficacy and permanence of this treatment with a large sample population. The use of SCL has the potential of providing a relatively simple and inexpensive adjunct to the current treatment of nystagmus.

The authors have no financial or other interest in any of the products or equipment used in this study.

SOURCES

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