Article ▸ Relieving Accommodative Spasm: Two Case Reports

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ABSTRACT

Background: Relief from accommodative spasm involves a long course of pharmacological treatment and/or vision therapy. Complete resolution is challenging, especially within a short time frame. This case report demonstrates a clinical management technique that instantaneously provided relief from accommodative spasm. A fogging technique modified from Borish's delayed subjective test was used to stabilize accommodation in two patients.

Case Report 1: A 14-year-old male child presented with 20/200 visual acuity and variable high myopic refractive error. Cycloplegic refraction showed low hyperopia. Atropine was used for 1.5 months. Upon discontinuation of the atropine, the child again developed accommodative spasm and was referred to our vision therapy clinic.

Case Report 2: A 10-year-old male child presented with 20/500 visual acuity and high myopia but showed low hyperopia upon cycloplegic refraction. At the post-cycloplegic visit, the child again exhibited accommodative spasm and was referred to our vision therapy clinic.

Conclusion: A modified fogging technique can be applied to relieve accommodative spasm for patients through optical means. A cycloplegic refraction is essential to determine the refractive error initially. The modified fogging technique can be applied during the post cycloplegic visit if the spasm recurs. Stability of accommodation and improvement in visual acuity is obtained with this technique.

Keywords: accomodative spasm, ciliary spasm, pseudomyopia, spasm of near reflex, vision therapy

Introduction

Accommodation is the process of increasing the plus refractive power of the crystalline lens, particularly for viewing closer objects. In rare instances, accommodation does not relax, even when viewing distance objects. Such patients are said to have accommodative spasm and typically exhibit increased myopia (or decreased hyperopia). Accommodative spasm, also referred to as pseudomyopia, hyperaccommodation, or ciliary spasm,[1-3] has only a fair prognosis.[4,5] This condition is commonly recurrent and complete resolution is rare; for some patients it can take several months to years to find relief.[2,5-9] Pharmacological relaxation of the accommodative spasm with strong cycloplegics such as atropine is commonly used for both diagnosis and management. The other commonly used treatment modalities to re-establish accommodative stability are the use of milder cycloplegics in tapering dosage, a reading add, vision therapy exercises, and sometimes a combination of cycloplegics and vision therapy.[2,10] There is no standard practice pattern for managing patients with accommodative spasm. The duration and dosage of the cycloplegia and the protocol for vision therapy is variable, as the presenting symptoms and signs differ.

This paper presents a treatment technique to relieve accommodative spasm instantaneously. The method is modified from Borish's delayed subjective test to relax accommodation. Borish reported a fogging technique (delayed subjective test) with which higher plus power (up to +1.00D) than what was obtained earlier in the subjective refraction can be prescribed.[11] Borish also mentions that the procedure may help to relieve some accommodative spasm, but in fact he was referring to accommodative excess. The difference between accommodative excess and spasm is explained by Scheiman and Wick.[12] In the typical Borish delayed subjective test, Negative Relative Accommodation (NRA) will be performed after the subjective refraction. In measuring the NRA, plus lenses in 0.25 D steps are added binocularly until the patient reports a sustained blur for the near target. Upon reaching this end point, the patient will then be instructed to look at the last line of the distance chart read earlier during the subjective refraction. This acuity line will be blurred for the patient. The patient is then defoggged binocularly, until s/he can report when this line is visible again. A variation of this technique recommends a strong fogging lens to relax accommodation.[13] The patient wears the strong fogging lens and is asked to look around in the waiting area and to avoid any near work. After some time, the patient is defogged to determine the final subjective acceptance value. The Borish delayed subjective test for patients with accommodative spasm has not been reported in the literature. Performing subjective refraction and NRA is difficult in cases of accommodative spasm, particularly when patients report constant blurred and fluctuating vision. Hence, the technique has to be modified to apply a similar principle and to stabilize the accommodation. Borish's original delayed subjective test relieved accommodation excess, but with this new technique, accommodative spasm can also be relieved. The technique has two phases, one for distance and one for near. Case reports of two patients who were relieved of their accommodative spasm with this technique are presented.

Case 1

A 14-year-old male had complaints of blurred distance and near vision along with headache and pulling sensation around the eyes for the past 20 days. His visual acuity (March 2016) was 20/200, N36 in each eye. His non-cycloplegic retinoscopy showed -7.00-1.00x090 in both eyes. His cycloplegic (with cyclopentolate 1% eye drops) retinoscopy revealed a refractive error of +1.00DS OU. His unaided visual acuity under cycloplegia was 20/25 OU and N6 with +3.00DS add. He was prescribed atropine 1% eye drops to be used at bed time for six weeks and reading glasses for near by his ophthalmologist. He was scheduled for a review after eight weeks (two weeks after stopping the atropine eye drops).

At the second visit in May 2016, the patient had visual acuity of 20/200 OU and 6Δ eso deviation (intermittent esotropia) for distance and near. There was no documentation of his ocular alignment in the first visit. The patient was referred to our vision therapy clinic with a diagnosis of accommodative spasm by the pediatric ophthalmologist. Upon examination, his binocular visual acuity was recorded as 20/159 (LogMAR acuity as calculated by COMPLog software, (Ver. 1.3.25.0, Bristol, UK)), with the patient complaining of intermittent doubling of the letters. Monocular visual acuity was 20/200 in each eye for distance and N6 at 10 cm for near, with no complaints of doubling. Non-cycloplegic retinoscopy showed a variable myopic reflex (~ -5.00 D), and dynamic retinoscopy showed a lead of accommodation. These findings confirmed the accommodative spasm. The modified Borish's delayed subjective test was administered and is explained below.

Distance Phase: In this phase, a +3.50DS lens was placed in a trial frame for both eyes, and the patient was asked to read a comic book with bigger font sizes (~N12) for 30 minutes binocularly. A +3.50DS was chosen because the cycloplegic refraction showed about +1.00DS; the sum of this and the typical NRA value of about +2.50DS gave the starting lens power. The book was held by the patient at a comfortable distance where the letters were clear and visible. Upon having the letters cleared, the patient was slowly encouraged to hold the book at a longer distance, with the aim of achieving about a 30 cm viewing distance, if possible, with clear vision. Following 30 minutes of reading, the patient was able to read the book between 20 and 25 cm. The patient was asked to look at the distance visual acuity chart showing the largest optotype and was binocularly defogged in 0.25D steps, and he was simultaneously encouraged to keep reading down the chart. With this procedure, under plano viewing conditions, the patient read 20/80 binocularly and complained of doubling of letters occasionally. Monocular visual acuity was 20/80+2 in each eye.

Near Phase: The next phase was to stabilize accommodation at near. Typically, the NRA and PRA (positive relative accommodation) procedures are performed binocularly to measure the range of disaccommodation and accommodation, respectively, by having the patient view a near target (N8) at 40 cm when holding the vergence posture as a constant.[14] This procedure, when performed monocularly, opens the fusional vergence loop and eliminates vergence-driven accommodation through the CA/C cross link.[15] Ignoring the tonic and proximal accommodation components, what remains is the blur accommodation. First, blur accommodation is stepped towards relaxation (disaccommodation phase) by adding plus lenses in 0.25D steps until the patient reports a sustained blur. The plus dioptric power is next stepped down by decreasing the plus power and progressing towards increasing the minus power (accommodation phase) in 0.25D steps until the patient reports a sustained blur. If the patient does not report a blur upon reaching -2.50D, the procedure is halted, and the lenses are stepped back (i.e. decreasing the minus power) in 0.25D steps until reaching plano (disaccommodation phase) and the patient reports clear vision. The procedure was then repeated for the other eye.

The patient monocularly viewed an N18 target at 35 cm for this testing procedure. This target size was chosen because it appeared clear for him at a viewing distance that was reasonably close to the regular near working distance. For this patient, the obtained values for the plus lens to blur and minus lens to blur were +3.25 and -2.50, respectively. Following this procedure, when asked to read, the patient read N6 binocularly at 40 cm and 20/25 in each eye at distance.

Retinoscopy was performed under this stable accommodative condition. Distance refractive error was observed to be +0.50DS in each eye. The reflex was now crisp and stable. Dynamic retinoscopy revealed a lag of +1.50DS in each eye. Dynamic retinoscopy was performed using the Monocular Estimate Method (MEM),[14] having the patient view a near card mounted to the Welch-Allyn retinoscope at a working distance of 66 cm. Cover test showed orthophoria for distance and near. Phoria status, measured using the VTS4 (www.visiontherapysolutions.net) at a viewing distance of 76 cm, showed orthophoria. Fusional ranges measured showed base in: 5Δ/3Δ (break/recovery) and base out: 20Δ/17Δ (break/recovery).

The patient felt comfortable with his vision at this point. He was advised to do home a vision therapy exercise for accommodative facility (+/-2.00D accommodative flippers) for monocular and binocular viewing conditions. He was also advised to practice vergence exercises with a Brock string and to maintain the beads as clear and single. Spectacles were not issued, and a follow up was scheduled in one month. At that visit (June 2016), he maintained his stable, clear, single vision. He read 20/20, N6 at 30 cm in each eye and had no visual complaints. His refractive error was +1.00DS (OD) and +0.75DS (OS). Dynamic retinoscopy showed a +0.75DS lag in each eye. With fogging, the patient read 20/20 with +0.75DS in each eye (Duochrome: red better),

Table 1. Summary of Clinical Findings for Both Cases

	Case 1 (14/m)	Case 2 (10/m)
First Visit		
Presenting distance visual acuity	OD: 20/200; OS: 20/200	OD: 20/600; OS: 20/500
Retinoscopy	OD: -7.00-1.00x090 OS: -7.00-1.00x090	OD : -8.00 DS OS: -8.00 DS
Cycloplegic refraction	OD: +1.00 DS [plano: 20/25] OS: + 1.00 DS[plano: 20/25]	OD: +0.75 DS (20/25) OS: +0.50 DS (20/20)
Post-Cycloplegic Visit		
Presenting distance visual acuity	OD: 20/200; OS: 20/200	OU: 20/159
Retinoscopy	Vacillating reflex, lead of accommodation	Vacillating reflex, lead of accommodation
Modified Borish's delayed subjective test (distance phase)	OU: plano (20/80)	OU: +0.50 DS (20/25)
Modified Borish's delayed subjective test (near phase)	OD: plano (20/25, N6) OS: plano (20/25, N6)	OD: +0.50 DS (20/20, N6) OS: +0.50 DS (20/20, N6)
Retinoscopy	OD: +0.50 DS OS: +0.50 DS	OD: +0.75 DS OS: +0.50 DS

but preferred plano (Duochrome: balanced). His near point of accommodation was 7.5 cm and 8 cm in the right and left eyes, respectively. Near point of convergence was 10 cm. Stereopsis with Randot circles showed 40". The patient had 6 cycles per minute (cpm) with the accommodative flipper (+/-2.00DS) and 1.5 cpm with vergence flipper (resultant 10Δ) and was asked to continue with his accommodative flipper and vergence exercises with the Brock string and return in three months. As the patient was from out of state, the father informed us over phone that the child was doing well, and they followed up locally.

Case 2

A 10-year-old boy was diagnosed with accommodative spasm in October 2016. The child had visual acuity of 20/600 and 20/500 in the right and left eyes, respectively. A variable reflex up to -8.00DS in both eyes was demonstrated in non-cycloplegic retinoscopy. Upon cycloplegic refraction, he was found to have +0.75 DS (20/25) in the right eye and +0.50 DS (20/20) in the left eye. He was given an appointment for our vision therapy clinic for further management.

In our clinic a week later, we measured his binocular acuity to be 20/159 by COMPLog in the distance and N12 at 10 cm. The father also reported that the child had pain in his eyes and blurred vision for one month. Retinoscopic reflex showed a vacillating reflex varying from with to against. Dynamic retinoscopy showed a lead of accommodation. The child was made to wear +3.00 DS lenses binocularly (accounting for a presumed normal NRA and the cycloplegic refraction) and was asked to read a story book for 30 minutes, after which the modified Borish delayed subjective test was performed (Distance Phase). Upon completion of this step, the child's binocular acuity was found to be 20/25 with +0.50 DS. The Near Phase, as described in Case 1, was then performed with the distance correction of +0.50 DS in place. Viewing an N10 target for this procedure, the plus lens to blur was +2.25 DS in each eye. The minus lens to blur was -2.50 DS in right eye and >-2.50 DS in left eye. Upon completion of this test, the child was now able to read N6 at 40 cm. The distance acuity now measured 20/20 in each eye with a +0.50 DS. Duochrome was red better with this prescription and green better without it. Retinoscopy was repeated, showing a clear crisp reflex. The values obtained were +0.75 DS (OD) and +0.50 DS (OS). Dynamic retinoscopy showed +0.75 DS (OD) and +1.00 DS (OS). The +0.50 DS was preferred by the patient and prescribed. This child was also from out of state and followed up locally. The father reported over the phone one month later that the child had clear vision and was comfortable with the spectacles.

Discussion

This is the first report to highlight an instantaneous relief of accommodative spasm through optical fogging methods. The modified Borish's delayed subjective test described here systematically and gradually stabilizes the accommodation. The two case reports are illustrative.

Both patients reported here have low hyperopic refractive status (Table 1). Low myopia, low hyperopia, or emmetropia is common in accommodative spasm.[6] The differential diagnosis for accommodative spasm includes convergence excess, accommodative excess, and high myopia. In the two patients reported here, high myopia was ruled out after cycloplegic refraction. Convergence excess was not demonstrated, as the phoria status was orthophoric. Accommodative excess was also ruled out since the patients presented with reduction in visual acuity and very high myopia that was relieved only with cycloplegic agents, thus confirming the diagnosis of accommodative spasm. The etiology for the accommodative spasm in these patients is unclear. Most of the reported cases on accommodative spasm or spasm of the near reflex (involving the near triad) typically report a functional cause of psychogenic origin.[5,6,9,16] In Case 1, the patient's history,

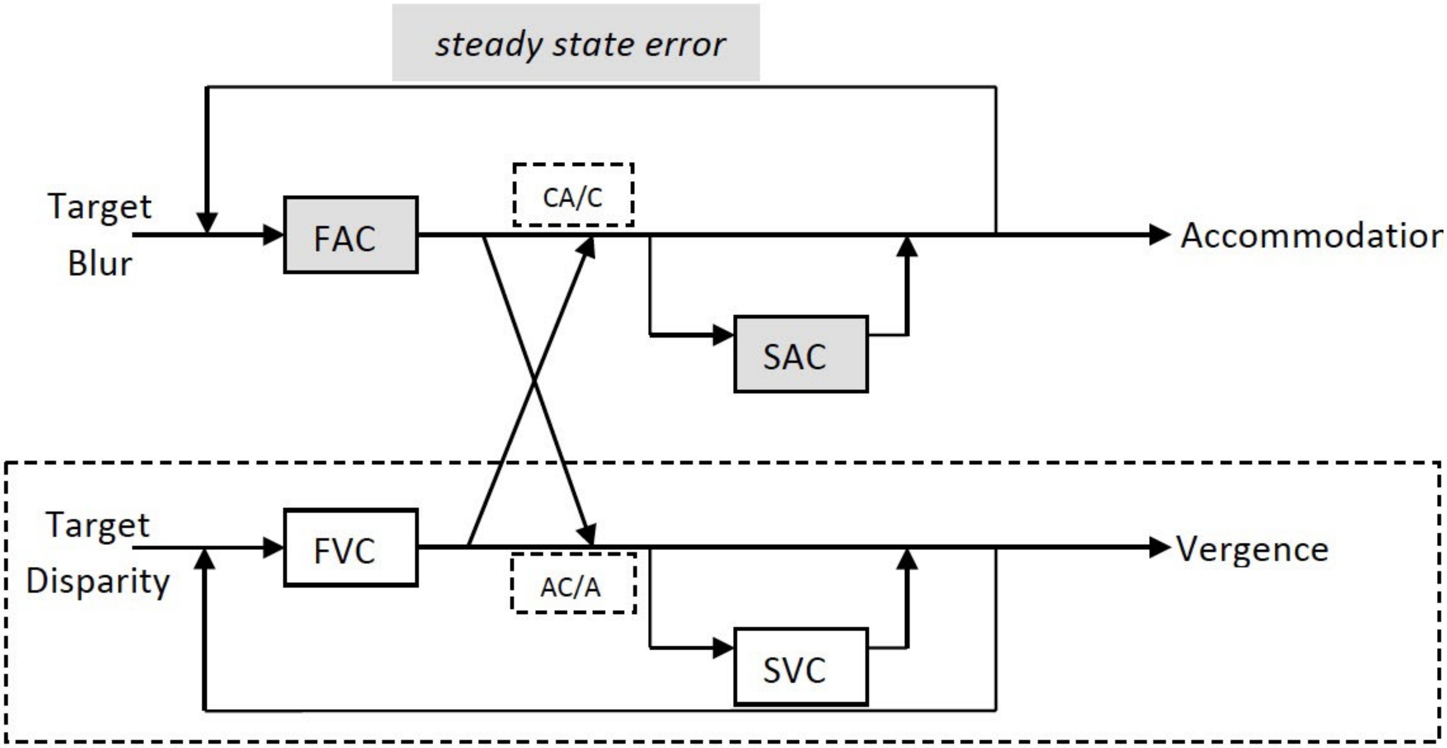

Figure 1. *Control system model for Accommodation and Vergence (modified from Satgunam, 2007[21]). In Distance Phase, both Accommodation and Vergence components are active. In Near Phase , one eye is occluded, thus opening the vergence loop (dotted lines). The gray shaded boxes are stabilized through the modified technique described in the paper. FAC- Fast Accommodative Component, CA/C- Convergence Accommodation/Convergence ratio, SAC- Slow Accommodative Component, FVC- Fast Vergence Component, AC/A- Accommodative Convergence/Accommodation ratio, SVC- Slow Vergence Component.*

both from the patient and his parents and uncle, did not reveal any emotional stress or change in life style or anything contributory for a functional origin for the accommodative spasm. This patient reads school text books, watches television, uses gadgets (cell phones and computers), and also plays outdoors. While his history was non-contributory, clinical findings after the patient recovered from the accommodative spasm revealed the accommodative facility, vergence facility, and negative fusional vergence to be lower than expected. However, the patient's positive fusional vergence range was within normal limits.[12] It may be possible that sustained accommodation and convergence for near work, along with inefficient negative fusional vergence, could have triggered the spasm. The intermittent double vision the patient reported indicates that the accommodative spasm also involved the vergence system, as expected through the AC/A cross link (Figure 1). Typically, when accommodation, convergence, and pupillary miosis are involved, the condition is referred to as spasm of the near reflex, although some authors suggest using this term even if only one component is involved.[5] In Case 2, the father reported that the child had a habit of holding books close to the face and sometimes reading the book in a supine position. It is possible that these reading habits and poor ergonomics for reading could have triggered the spasm in this patient. This patient was subsequently advised on proper reading ergonomics.

There is only limited success with cycloplegic agents such as atropine to 'treat' accommodative spasm. There are also cases in the literature where atropine does not relieve the accommodative spasm after the cycloplegic effect weans away as in Case 1. Only 4 of the 17 cases in a case series report[2] had complete resolution of their accommodative spasm. The majority of patients continue to have recalcitrant accommodative spasm, and for some patients, the spasm continues for several years.[2,9] Instances of relief of accommodative spasm through only vision therapy exercises is also a rarity. Accommodative excess, on the other hand, responds well to vision therapy exercises.[12] The patient in Case 1 was exposed to the atropine eye drops on the first visit prior to the evaluation in the vision therapy clinic. The impact of the atropine on the modified technique that was performed would have been minimal. One can assume that the patient went back to his original spasm status as measured during the first visit, because the visual acuity and refractive error were comparable. Therefore, it is safe to assume that the modified Borish delayed subjective technique would have produced the same result, regardless of the use of the atropine. In Case 2, the patient was examined after the usual cycloplegic refraction routine. No atropine was needed in this case, and the patient had an instantaneous relief of his spasm with the modified technique.

The exact mechanism for how this modified fogging technique works effectively is not clear. A speculation using the accommodation control system model (Figure 1) on how this technique potentially works is described as follows. In accommodative spasm, the varying retinoscopic reflex indicates that the refractive error is varying, indicating that the accommodative response is not stable. The higher myopic refractive error indicates that the accommodation is in excess of what is required for the target blur demand. This erroneous response and accommodative instability offsets the balance of the closed negative feedback loop of the accommodative control system model. Specifically, the accommodative component in the control system comprises two components: the fast (phasic) component and the slow (tonic) component, also described as accommodative adaptation. Both of these components (grey boxes in Figure 1) would be responsible for the overdrive in the accommodative response. In general, the lag of accommodation, considered as the steady-state error of the accommodative system, depends on the combination of the fast and slow components through the neural integrator.[17] In accommodative spasm, a lead of accommodation is seen instead of a lag. The two components (slow and/or fast) in overdrive could have shifted the steady-state error to a lead, breaking the control system feedback loop. The modified Borish delayed subjective technique attempts to reset this feedback loop.

In this technique, first the patient is made to relax their accommodation wearing a plus lens with a magnitude slightly higher than the expected average NRA value (+2.50 DS) for a prolonged duration (30 minutes). Typically, accommodative adaptation begins within 1-2 minutes.[17,18] The relaxing plus lens with prolonged reading would begin the negative accommodative adaptation: in other words, disaccommodation (discharging the slow leaky neural integrator, SAC in Figure 1). Next, the patient is gradually defogged, simultaneously being encouraged to read the distance visual acuity chart (target blur signal). The end point for the defogging is the best possible acuity level with maximum plus for maximum visual acuity.[14] It is possible that the patient can stabilize their accommodation with just the Distance Phase and improve their acuity. However, it was observed that the retinoscopic reflex looked more stable after proceeding with the Near Phase for both of these patients.

The Near Phase in this technique essentially steps the accommodation down and up in quicker succession to engage the fast (phasic) component of the accommodative system (FAC in Figure 1). This stepping could re-stabilize the phasic accommodative component in the control system. With a viewing condition that has decoupled vergence and accommodation by occlusion of the non-tested eye, only the blur accommodation feedback loop is used. An important step in these techniques is that at both distance and near, the patient was made to view the visible targets so that he could read and report blur when noticed. Providing this target visibility was also helpful to get the accommodation stabilized through the closed feedback loop that is driven by target blur. As accommodation is expected to be a binocular phenomenon, the occluded eye's accommodation should have also changed through the disaccommodating process along with the viewing eye. Thus, each eye gets to cycle through disaccommodating (fogging), accommodating (defogging), and then again disaccommodating back to baseline, for a total of two times. This smooth transition perhaps resets the neural gears of the lens' focusing mechanism to its original baseline. Upon stabilizing the accommodation, the patient is now made to view the near target binocularly. This brings back the vergence mechanism to give single vision under stable accommodating eyes, thus achieving clear, single and stable vision for both distance and near.

It is unclear whether this technique will be applicable to other varieties of accommodative spasm cases, such as spasm occurring secondary to occlusion, trauma, psychogenic associations, presenting after LASIK, etc.[7,9,19,20] More clinical studies and case series will be needed to show the repetition of success with this technique in such cases and in ones similar to those presented in this paper. While the proposed technique may appear time-consuming, it is not invasive or expensive and does not carry any side effects associated with the use of cycloplegic medications. If cured instantaneously (i.e., getting relief from the accommodative spasm), then several vision therapy visits can also be avoided, saving time and money for the patient.

Conclusion

Etiology and treatment options for accommodative spasm are ambiguous. While cycloplegic medications help in giving a confirmatory diagnosis of accommodative spasm and in quantifying the actual refractive error, relief from recalcitrant spasm with cycloplegics can be a long ordeal. The modified fogging technique described here is a cost effective and easy solution that can be attempted in patients who have accommodative spasm.

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