Cyclotherapy as a Technique to Expedite the Treatment of Hyperopic Amblyopia

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ABSTRACT

Amblyopia is one of the most common causes of vision loss in children. This paper shows the efficacy of cyclotherapy in facilitating plus acceptance to expedite the treatment of refractive amblyopia.

Three cases of hyperopic amblyopia underwent cyclotherapy.

Best corrected visual acuity improved by at least one visual acuity line after cycloplegic refraction for all three patients as compared to dry manifest refraction. After treatment with cyclotherapy, acuities were equal to the initial cycloplegic refraction at the first follow-up visit with full spectacle correction. The full plus acceptance allowed for quicker resolution of refraction correction in the treatment of amblyopia. The use of cyclotherapy is effective in facilitating plus acceptance in hyperopic amblyopic eyes, and it expedites the resolution of amblyopia.

Amblyopia is a visual disorder characterized by decreased vision with an amblyogenic factor in the absence of pathology. It is caused by abnormal visual experience during a sensitive period of visual development in early childhood. It affects up to 3.5% of children and is the most common cause of vision loss in children and young adults.

Proper diagnosis of the type of amblyopia is essential for its prognosis and treatment. There are several types of amblyopia but this paper will focus on refractive amblyopia due to hyperopia.

The treatment of amblyopia can commonly be broken down into three phases: refractive correction, passive therapy and active therapy. Generally, initial treatment involves appropriate optical correction with spectacles and/or contact lenses. Once visual acuity plateaus with optical correction, passive therapy such as patching or atropine penalization can be implemented to improve vision. Finally, active therapy such as in-office vision therapy can be incorporated to further resolve the amblyopia. Compliance with spectacle wear, passive therapy, and active therapy are very important to success. This paper will focus on the first phase in the treatment of amblyopia: refractive correction.

Refractive amblyopia treatment always begins with the most appropriate refractive correction. Results from the Amblyopia Treatment Studies (ATS) investigated by the Pediatric Eye Disease Investigator Group (PEDIG) have shaped the way modern clinicians manage and treat amblyopia. Treatment of refractive error alone for 18 weeks can improve vision in the amblyopic eye by two or more lines in at least two thirds of the children 3 to 7 years old who have untreated anisometropic amblyopia. Improvement of two or more
This paper presents a series of three case reports where cyclotherapy was successfully implemented and expedited the resolution of amblyopia. The goal of cyclotherapy is the improvement of the initial visual acuity. By creating a better initial best corrected visual acuity, the process of amblyopia therapy should be shortening therefore expediting the management of amblyopia in patients with hyperopic amblyogenic factors.

**CASE REPORTS**

Three patients were retrospectively reviewed from Bronx-Lebanon Hospital Center (BLHC). Two cases were of isometropic hyperopia and one was of anisometropic hyperopia, patients had a cycloplegic refraction and were diagnosed with amblyopia due to hyperopia. The American Optometric Association’s definition of refractive amblyogenic factors are 5.00D of hyperopia and 1.00D of anisometropia. Two patients had amblyogenic factors of 5.00 D or more hyperopia and one patient had an anisometropia of more than 3.00 D. Indication for cyclotherapy treatment included poor visual acuity (BCVA less than 20/20) upon dry manifest refraction with improved visual acuities after a cycloplegic refraction. Improvement was defined as an increase of at least one line in visual acuity testing during cycloplegic manifest refraction. At the end of the initial examination, a spectacle prescription with 1D less than the full cycloplegic refraction was given. This amount was decreased to compensate for tonic accommodation lost during cycloplegic refraction. There is no optical at the hospital so all spectacles were received outside of BLHC. Patients were educated to refrain from wearing their glasses before the dispensing visit with the eye care provider.

On the dispensing visit, BCVA with the new spectacle was measured. If the BCVA was not as good as what we had measured in the previous exam with cycloplegia then cyclotherapy was performed. Instillation
of 1gtt 0.5% Proparacaine, and 2gtts 1% Cyclopentolate separated by five minutes (same drops used for diagnosis) were given. The patient waited for 30 minutes before wearing their glasses. BCVA with the spectacle after cyclotherapy was recorded. Patients were instructed to wear their new spectacles full-time until bedtime. Parents and patients were advised to restrict any near point activities for the day. If this was not possible, a clip-on add was recommended for use during the early part of the day when cycloplegia was most active. Patients were educated that if distance blur was experienced the following morning, they should return to re-administer the cycloplegic drops. Otherwise, a one-week follow-up was scheduled. All three cases shown had improvements of BCVA with the same spectacle after cyclotherapy compared to prior. None of the three cases needed a clip-on add or a re-administration of the drops.

**Visual acuities with spectacles and over-retinoscopy were evaluated at each follow-up visit after cyclotherapy. Spectacles were changed accordingly if acuities improved with retinoscopic findings.**

Parents were strongly educated on the importance of returning for follow-up examinations and full-time wear of spectacle correction at each visit.

**RESULTS**

**Case 1**

A 6-year-old black male was referred by his pediatrician for a first-time eye exam due to a failed vision screening. The patient and mother reported no visual complaints at initial examination. Past medical history was unremarkable. His mother reported an unremarkable pregnancy, normal developmental milestones, and that he was at grade level in school.

Unaided visual acuity was found to be 20/40- in the right eye and 20/40- in the left eye. The patient was able to appreciate Random Dot Stereogram (RDS) of 250 seconds of arc. Dry retinoscopy (objective finding) revealed +2.50 - 1.00 X 180 in both eyes. Dry manifest (subjective) findings were OD +2.00 - 1.00 X 180 and OS +1.75 - 1.00 X 180. Best-corrected acuities at this time were OD 20/30+ and OS 20/30+. Cycloplegic retinoscopy (objective) findings of OD +5.00 - 1.00 X 180 and OS +4.75 - 1.00 X 180. Best-corrected acuities (cycloplegic manifest) with this finding were OD 20/25+2 and OS 20/25+2. He was diagnosed with isometropic refractive amblyopia with poor plus acceptance and moderate hyperopia with astigmatism. The final prescription given was OD +4.00 - 1.00 X 180 and OS +3.75 - 1.00 X 180.

On the day of dispensing, cyclotherapy was administered and glasses were dispensed after 30 minutes. BCVA with the spectacle without cyclotherapy was 20/40- OD/OS, after cyclotherapy, the BCVA was 20/25+ OD/OS. This gave an immediate visual acuity improvement of two lines. The patient returned one week later with no visual complaints. Mother reported excellent compliance with full-time wear. Acuities at this time were OD 20/25+2 and OS 20/25+2. Over-retinoscopy revealed OD +1.00 - 0.50 X 90 and OS +0.50 - 0.50 X 90, however acuities did not improve, so the prescription was not changed. The patient was educated to continue wearing full-time and return in three months for follow-up.

The patient did not return until 9 months later. The mother still reported full-time wear with glasses. The patient reported no visual complaints. Acuities at this time were 20/20 OD and 20/20 OS. Over-retinoscopy revealed OD PI - 0.25 X 90 and OS +0.25DS. The prescription was not changed, as the change was minimal. The amblyopia at this time is resolved. The patient was educated to continue wearing glasses full-time and to be monitored for long-term stability thereafter.

**Case 2**

A 17-year-old Hispanic female was complaining of decreased vision OD with
tearing and some discomfort. She has a history of spectacle wear as a child with poor compliance. Past medical and developmental history was unremarkable.

Unaided visual acuity was found to be 20/30 in the right eye and 20/20 in the left eye. Dry retinoscopy revealed OD +3.75-0.25x90 and OS +1.25 with fluctuating results. Dry subjective manifest findings on the right eye ranged from Plano to +1.25DS with sporadic acceptance of the later lens. Best-corrected visual acuity with +1.25DS in the right eye was 20/70. Cycloplegic retinoscopy finding was OD+4.00-0.25x15 and OS +0.50DS. With a wet subjective manifest refraction of OD +3.75DS OS +0.50DS, acuities were OD 20/25 and OS 20/20. Patient also had intermittent suppression on Random Dot stereo shape test. It is thought that the patient is most likely symptomatic due to this intermittent suppression. This patient was diagnosed with anisometropic amblyopia and moderate hyperopia in the right eye. The final prescription given was OD +3.25DS and OS pl. The patient was educated to return for dispensing and cyclotherapy.

The patient never returned until 6 months later because she did not get the glasses right away as directed. When she finally obtained the glasses, she reported that she does not use them because she cannot see through them. On this visit, her visual acuity with spectacle correction of OD +3.25DS was finger counting at 8ft and OS pl was 20/20. Cyclotherapy was performed and glasses were dispensed 30 minutes later. Her vision on the right eye with +3.25DS was now 20/25 OD. She was then fitted with Acuvue Oasys BC 8.4 Dia 14.0 +3.25DS OD since she did not want to wear spectacles. On follow-up visit, her vision with the contact lens was 20/20-1. Anisometropic amblyopia was considered resolved at this time. She will continue to be followed for long-term stability.

**Case 3**

A 5-year-old black female was referred by her pediatrician for a first-time eye exam due to a failed vision screening. The patient presented with her grandmother, who reported that the patient sat closely to the TV and disliked reading or performing near tasks. The patient denied any visual or asthenopic complaints. Past medical history was unremarkable. The grandmother reported an unremarkable pregnancy, normal developmental milestones, and grade level skills.

Unaided visual acuity was found to be 20/40 in the right eye and 20/50 in the left eye. Dry retinoscopy revealed OD +5.00 - 1.50 X 180 and OS +5.00 - 2.00 X 180. Dry subjective manifest findings were OD +6.50 - 1.50 X 180 and OS +6.50 - 1.75 X 180. Best-corrected acuities with this refraction were OD 20/40 and OS 20/50. Cycloplegic retinoscopy findings were OD +8.50 - 1.00 X 165 and OS +9.50 - 1.75 X 180. With a wet subjective manifest refraction of OD +7.50 - 1.00 X 165 and OS +8.50 - 1.75 X 180, acuities were OD 20/25 and OS 20/50. This patient was diagnosed with isometropic amblyopia and high hyperopia, greater in the left eye. The final prescription given was OD +7.50 - 1.00 X 165 and OS +8.50 - 1.75 X 180. The patient was educated to return for dispensing and cyclotherapy.

At the dispensing visit, BCVA without cyclotherapy was 20/50+ OD, 20/50-- with lots of effort OS. Cyclotherapy was administered and glasses were dispensed after 30 minutes. The BCVA after cyclotherapy was 20/30 OD and 20/50 OS. The patient returned one week later with no visual complaints. The grandmother reported excellent compliance with full-time wear. Acuities at this time were OD 20/30 and OS 20/50. Near cover test revealed 4 prism diopters exophoria with her full correction as oppose to her 18 prism intermittent alternating esotropia. The patient was educated to continue wearing the glasses full-time and return in one month for follow-up.

The patient returned two months later. The grandmother reported that the child wore the glasses full-time, and had no visual complaints. Acuities at this time were OD 20/25- and OS
20/30. Over-retinoscopy revealed OD +0.75DS and OS +0.50DS. Acuities did not improve with over-retinoscopy so the prescription was not changed. The patient was educated to continue wearing glasses full-time and return in two months for follow-up.

At the follow-up visit, the grandmother reported good compliance with spectacle wear. Acuities at this time were OD 20/25 and OS 20/30. Over-retinoscopy revealed OD +0.25DS and OS -0.50DS. With the additional -0.50DS over the left eye, the visual acuity improved to 20/25. Diagnosis at this time was resolving isometropic amblyopia, and the left spectacle prescription was changed to OS +8.00 - 1.75 X 180. The patient and grandmother were educated to continue wearing the spectacles full-time and to return in two months for follow-up.

The patient returned two months later, and the grandmother reported that the child showed improvements in her reading skills and was able to perform prolong near tasks. Acuities at this time with the new prescription OD +7.50 - 1.00 X 180 and OS +8.00 - 1.75 X 180 were OD 20/25 and OS 20/25. The patient was able to appreciate 20 seconds of arc on Wirt circles. Over-retinoscopy revealed OD -0.50DS and OS +0.25DS but the prescription was not changed at this time due to the minimal changes. Isometropic amblyopia was considered resolved at this time. She will continue to be followed for long-term stability.

DISCUSSION

Cyclotherapy is an innovative way to facilitate plus acceptance in a hyperopic amblyopic patient, provided that they meet the indications for treatment. Indication for treatment is improved visual acuity after cycloplegic subjective manifest refraction as compared to dry subjective manifest refraction.

In many of these cases, immediate full refractive correction would not be possible without the aid of cyclotherapy. In the example of Case 2, although the patient had 20/20 VA OS unaided, she was uncomfortable and constantly tearing in her right eye due to her intermittent suppression and decrease VA. This symptomatic patient had poor plus acceptance with a prescription of +3.25DS OD. Her acuity on the right eye was counting fingers without cyclotherapy because the plus lens was making her blurry, even with +1.25DS as shown on the dry Manifest her BCVA was 20/70. However, after instillation of cyclopentolate (cyclotherapy), the acuities immediately improved to 20/25 OD. This is a tremendous improvement in the initial BCVA. Prescribing this much plus at the initial visit decreased the patient’s acuity without cyclotherapy and this would have resulted in poor compliance with spectacle wear again. This patient reported poor compliance with spectacle wear in the past because she could not see well out of her old glasses. If the full correction had not been prescribed, then traditional treatment would have been for the patient to return for repeated follow-ups and gradually increase the prescription as the patient accepts more plus. This would have resulted in multiple visits and multiple spectacle changes. In this particular case, the amblyopia essentially resolved in the right eye within one to two visits.

These case series demonstrate the use of cyclotherapy and its effectiveness in patients with hyperopic refractive amblyopia. Keep in mind that not all refractive amblyopia needs all three stages of treatment, but they all need the first phase: refractive correction. By providing full refractive correction, the visual cortex has the ability to process a clearer image to help lessen or resolve amblyopia. The three cases presented all had improved visual acuity with the spectacle prescription with cyclotherapy on the day of the dispensing visit as compared to the visual acuity with just the spectacle prescription alone. Cyclotherapy can provide immediate acceptance through the full refractive correction at the time of dispensing, with gradual adaptation.
throughout the day. This may eliminate the need for partial prescriptions. It decreases doctor- chair time, follow-up examinations, and is an economically beneficial and efficient way of managing hyperopic refractive errors in amblyopic patients.

The results of these case series show potential for the use of cyclotherapy. Visual acuity for all three amblyopic cases was greater post cyclotherapy compared to dry subjective manifest refraction. Cyclotherapy expedites the treatment and resolution of the amblyopic eye. In these cases, we know that cyclotherapy worked because the starting visual acuity improved immediately after cyclotherapy compared to prior on the dispensing visit and remained on the follow up visits. The dry objective retinoscopy showed acceptance of the full plus prescription given as well on the follow up visits.

Consideration of cyclotherapy is appropriate in patients with hyperopic amblyopia that improve with a cycloplegic subjective manifest refraction. Table 2 describes a step-by-step approach for other clinicians to utilize cyclotherapy in primary care settings. Although cyclotherapy appears to be effective, there is a paucity of available clinical studies. While the results of these case series are promising, a larger controlled clinical trial is warranted to support this theory. With clinical trials, we would be able to place a numerical value on the timeline difference between those treated with cyclotherapy and those without as well as the time it took for the resolution between the two.

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REFERENCES


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Dr. Zhu-Tam graduated from the State University of New York, State College of Optometry. She completed her residency program at The Eye Institute of the Pennsylvania College of Optometry, Salus University in the specialty area of pediatric and binocular vision. Dr. Zhu-Tam has held faculty appointments at SUNY College of Optometry, where she taught optometry students and residents in the areas of pediatrics, binocular vision and primary care.

Currently, she is the Director of The Optometry Residency Program and the Pediatric Optometrist at BLHC; she is a certified fellow of the American Academy of Optometry, an associate member of the College of Optometrists in Vision Development and currently holds adjunct faculty appointments at the SUNY College of Optometry.
Case Final Rx VA prior to Cyclotherapy VA after Cyclotherapy F/u #1 F/u #2 F/u #3 F/u #4
1 OD 20/40 - +2.50-1.00x180 +2.00-1.00x180 20/30+ 5.00-1.00x180 20/25+2 1+ line
OS 20/40 - +2.50-1.00x180 +1.75-1.00x180 20/30+ 4.75-1.00x180 20/25+2 1+ line
2 OD 20/30 +3.75-0.25x90 +1.25 DS 20/70 4.00-0.25x15 +3.75DS 20/25 5+ line
OS 20/20 Pl to +1.25DS fluctuating pl 20/20 0.50DS 20/20
3 OD 20/40 +5.00-1.50x180 +6.50-1.50x180 20/40 8.50-1.00x165 7.50-1.00x165 20/25 2+ line
OS 20/50 +5.00-2.00x180 +6.50-1.75x180 20/50 9.50-1.75x180 8.50-1.75x180 20/50 0

Table 2. Cyclotherapy Technique

<table>
<thead>
<tr>
<th>Step 1 (Indications)</th>
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<tbody>
<tr>
<td>Diagnosis of hyperopic refractive amblyopia</td>
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<tr>
<td>Decreased VA with dry manifest refraction but improved visual acuities after a cycloplegic subjective manifest refraction</td>
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<td>Improvement is defined as an increase of at least 1 line in visual acuity</td>
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<tr>
<th>Step 2 (Spectacle Prescription)</th>
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<tr>
<td>Rx a spectacle prescription with no less than 1D of their full cycloplegic hyperopic refraction</td>
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<tr>
<td>This amount is decreased to compensate for tonic accommodation lost during cycloplegic refraction</td>
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<tr>
<td>Refrain from wearing the glasses before the dispensing visit</td>
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<tr>
<th>Step 3 (Dispensing / Cyclotherapy visit)</th>
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<tr>
<td>Instill 1gtt 0.5% Proparacaine, and 2gtt 1% Cyclopentolate separated by 5 minutes</td>
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<tr>
<td>Dispense new glasses after 30 minutes of instillation</td>
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<tr>
<td>Instruct patients to wear new glasses full-time until bedtime</td>
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<tr>
<td>Advise parents and patients to restrict any near point activities throughout the day</td>
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<tr>
<td>If distance blur is experienced the following morning, return to clinic for repeat of the procedure.</td>
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<tr>
<td>Otherwise return in one week for follow-up</td>
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<th>Step 4 Amblyopia therapy</th>
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<tr>
<td>Continue with standard refractive amblyopia therapy</td>
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Note:
Amblyopia = BCVA less than 20/20 with amblyogenic factors and in the absence of pathology
Cyclotherapy took place on the day of the dispensing visit
Dry BCVA = dry subjective manifest
Wet BCVA = Cycloplegic subjective manifest
*Wet = cycloplegic refraction with 2 gtt of 1% cyclopentolate
**BCVA change measured by line with Snellen acuity chart from dry subjective manifested BCVA to cycloplegic subjective manifest BCVA
CF= counting fingers