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Current trends in amblyopia therapy: Atropine penalization

Jeremy Bean  
Pacific University

Joanna Stedman  
Pacific University

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Abstract
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CURRENT TRENDS IN AMBLYOPIA THERAPY:
ATROPINE PENALIZATION

By

JEREMY BEAM
JOANNA STEDMAN

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
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Advisor:

RICHARD LONDON, OD, FAAO
Biographies:

Jeremy Beam began college in 1996 at Walla Walla College and in the summer of 1997 he married his high school sweetheart Angela. In 2000 he graduated with a Bachelor of Science degree in Biology. While in optometry school he was privileged to be able to participate in two trips with the international outreach group Arnigos to Oaxaca City, Mexico and the Ixcan region, Guatemala. When graduation arrives he will enter private practice.

Joanna Stedman graduated from Brigham Young University in 1996 with a Bachelor of Science in Zoology. In optometry school, she has served for 3 years as the class equipment representative, and one year as the class faculty representative. In 2001 she traveled with the Amigos Program to Santiago Chile where she and 14 others helped over 1200 children and adults with their eye care needs during their five-day clinic. She is active in the Optometric Physicians of Washington. After graduation, she will be specializing in pediatric optometry.
Abstract:

The Pediatric Eye Disease Investigator Group reported the prevalence of amblyopia to be between 1% and 4% making amblyopia the most common visual impairment in children. The classic and simple method of patching the non-amblyopic eye has been a mainstay of initial amblyopia treatment for most eye practitioners. This penalizes the sound eye and requires the amblyopic eye to be used. However, in the first phase of the Amblyopia Treatment Study researchers found that there was no significant difference in effectiveness between patch and atropine therapy over a six month therapy period. ATS 1 proved equal effectivity showing that the six-month acuity had improved from baseline by 3 or more lines in 79% of the subjects in the patched group and 74% for the atropine group. While each method of treatment has advantages and disadvantages for use, we find that atropine offers a mode of treatment with improved cosmesis, ease of administration and a potential for increased compliance with children who are resistant to traditional amblyopia treatment.

Key Words: amblyopia, Amblyopia Treatment Study, anisometropia, atropine, children, compliance, congenital cataracts, cosmesis, deprivation amblyopia, high refractive error, neural inhibition/stimulation, occlusion therapy, optical penalization, patching, PEDIG, stereopsis, strabismus, vision loss, visual acuity, visuoscopy.
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Introduction

One of the great challenges facing eye care practitioners when providing care for pediatric patients is the treatment and management of amblyopia. The visual system of young children is actively evolving and is sensitive to disruption. When this disruption occurs during a sensitive developmental period the brain undergoes adaptation to compensate. This commonly involves the active suppression of the disadvantaged eye, which is termed amblyopia. The major causes of amblyopia are strabismus, anisometropia, high refractive error, deprivation amblyopia caused for example by congenital cataracts or ptosis, or a combination of the above. In order to improve the visual acuity of the amblyopic eye, the amblyogenic stimulus must first be removed and second, the amblyopic eye must be given an advantage over the dominant eye.

While treatment typically consists of a simple patching regimen, amblyopia is still the leading cause of preventable vision loss in children and young adults under age 45. The prevalence of amblyopia is estimated at 2-2.5% in the general population, which translates to approximately 7,500,000 cases in the U.S.’ Although amblyopia is primarily defined by a level of reduced visual acuity, it has a negative impact on accommodative, binocular, and oculomotor functions as well. This unilateral vision loss ultimately leads to decreased stereopsis, which can affect eye-hand performance and overall coordination. Another major concern for children with amblyopia is the fact that there is a higher risk of injury to the sound eye than in children with two normally functioning eyes. It is therefore imperative that eye care physicians fully understand the latest research and treatment paradigms regarding effective management of patients with amblyopia.
Proper Assessment of Amblyopia

Before deciding to initiate on a treatment plan for amblyopia, it is vitally important to properly assess the patient's visual status. Since a diagnosis of amblyopia is one of exclusion, a proper amblyopia work up not only involves testing of refractive error and visual acuity, but also includes a precise measurement of strabismus, visuoscopy, and a full assessment of ocular health. Once amblyopia is diagnosed, the correct type of amblyopia must be determined because the treatment differs.

Strabismic amblyopia occurs due to a constant strabismus with an onset before the patient is 6 years of age. Intermittent and alternating strabismic deviations, without other complications, do not cause amblyopia. Diplopia and/or visual confusion associated with a deviation of the visual axis in the strabismic eye lead to suppression of the deviated eye. This inhibition then results in cortical spatial changes and decreased visual acuity.

Anisometropic amblyopia, due to unequal refractive error, causes an inhibition of one eye due to unequal image clarity. Isometropic amblyopia is due to high bilateral uncorrected refractive error and causes a bilateral reduction in acuity levels. Deprivational amblyopia is the most serious of amblyopia causes. This occurs when there is a physical obstruction of the line of sight such as ptosis, corneal opacities, or congenital cataracts. These patients have a much worse prognosis for improvement due the fact that most of these retinal cells have been unable to receive any neural stimulation.

No matter the cause of the amblyopia, poor visual function found in the amblyopic eye is due to direct neural inhibition. In a single unit recording analysis of the striate cortex neurons of macaque monkeys, both anisometropic and strabismic amblyopes had a reduced response to high spatial frequency signals in the amblyopic eye.
The investigators learned that the high spatial frequency neurons of the better sighted eye suppress the response from the amblyopic neurons.6 This suppression which results from unequal inputs was significantly decreased when input from the non-amblyopic eye was eliminated. Three things must be present to allow for normal processing and image fusion: image resolution, image similarity and common directionality. Anisometropia and strabismus cause the images to be dissimilar quality or location in space, leading to an inability to assimilate/integrate the images, which disrupts sensory fusion. In order to stimulate clear functional vision in the amblyopic eye, the visual input from the dominant non-amblyopic eye must be blocked or penalized, so that the brain is forced to utilize the amblyopic eye, encouraging the development of normal neural integration. The ultimate goal of amblyopia treatment is to improve the visual function of the amblyopic eye, and, if possible, balance the visual input from both eyes setting the stage for normal visual processing and sensory fusion.
The Ideal Amblyopia Treatment

The perfect amblyopia treatment would be well tolerated by patients and their parents (who are ultimately responsible for following through with the treatment). It would be simple and effective, and achieve a maximal acuity in the shortest amount of time. For the parent, the perfect treatment would be both time and cost efficient. For the child, the perfect treatment would allow no interruption of current activities, be painless, and allow the child to maintain good cosmesis, or at least be undetectable by his peers. Additionally, the treatment must not have adverse effects, such as causing the vision development of the dominant eye to be sacrificed (reverse, or occlusion amblyopia), or increasing the frequency of strabismus due to disruption of unstable fusion. While occlusion therapy is a well-known option in the treatment of amblyopia, atropine has also become an accepted and effective treatment option.
Occlusion Therapy, the Gold Standard:

The mainstay of amblyopia treatment has been and continues to be occlusion therapy. Occlusion treatment involves patching the non-amblyopic eye for a specified number of hours each day with an adhesive patch or spectacle mounted cloth patch. One of the major benefits of occlusion therapy is that it gives the doctor flexibility to customize the treatment according to the needs of each individual patient case (i.e. increasing or decreasing the number of hours). Another benefit is the fact that when the patient is wearing the occlusive patch the dominant eye is fully occluded thereby breaking the cycle of suppression that reinforces the amblyopia. This is especially helpful when treating constant strabismic amblyopes who often have binocular sensory adaptations in addition to amblyopia.

While occlusion therapy has been shown to be an effective treatment there are significant drawbacks. Compliance with occlusion therapy is the major disadvantage of this mode of amblyopia treatment. It is very often a struggle to achieve an adequate level of compliance with patching, especially in young children. They often dislike wearing the eye patch for several reasons. First, forcing them to use their amblyopic eye causes them to have reduced visual acuity, at times drastically reduced, affecting their ability to function at school or at home. Second, the patch is cosmetically noticeable, causing them to stand out from their peers. School aged children are mindful of the social implications of being different than other children, so the social stigma of wearing the patch can cause resistance on the part of both the child and parent. Third, the adhesive patches may cause a skin irritation or problems with sweating during active play, especially in the summertime. Because of these problems with patching, patients are constantly inventing
ways of removing and/or peeking around the eye patch unless they are constantly supervised by an adult. With the increasing number of working mothers leading to multiple care-providers, there is often much less parental supervision than needed to maintain appropriate compliance. \(^8\) Ironically, the poorer the acuity, the more need for the treatment, but these are often the patients who most strongly resist treatment with patching. \(^2\)

Another disadvantage, not noted by children and not affecting compliance, yet quite important, is that patching may disrupt binocularity in cases where this is not desirable, such as anisometropic amblyopes and intermittent strabismics. With these patients it may be more beneficial to avoid total monocular occlusion as this may breakdown their fragile binocular system. For these patient types atropine therapy, which does not fully occlude the dominant eye may be a more appropriate therapy choice.
Benefits and Drawbacks to Atropine therapy:

Early in the twentieth century, Worth advocated monocular instillation of atropine as a treatment option for amblyopia. While some eyecare professionals have used atropine penalization to treat amblyopia it has not become a mainstream treatment choice. As demonstrated by the Pediatric Eye Disease Investigator Group (PEDIG) in Amblyopia Treatment Study 1 (ATS1), pharmaceutical penalization with atropine is a viable option for treating amblyopia. Atropine therapy is accomplished by the instillation of 1% atropine in the non-amblyopic eye, usually on a daily regimen. The resulting cycloplegia induces blur at near viewing distances in the dominant eye. This encourages the patient to use the amblyopic eye for near fixation, providing visual stimulation for a significant portion of each day.

The success of any amblyopia treatment ultimately depends on compliance. With atropine there is potential for increased compliance due to several factors. First, there is less cosmetic effect with atropine, since anisocoria carries less social stigma than wearing a patch – especially in patients with dark irides. Second, there is also typically less emotional trauma with the instillation of drops compared to patching therapy. There is little to no stinging with atropine compared with many other drops because the pH balance is more isotonic with the cornea. It is easier to instill a drop that takes a few minutes then to force a child to wear a patch for hours. Third, with atropine penalization, there is no ability to peek around the pharmacologic "occlusion". Fourth, atropine treatment becomes a viable option for kids who develop skin sensitivity with the use of an adhesive eye patch. And fifth, with intermittent strabismic patients with fragile binocularity, atropine does not fully occlude, allowing some form of lower level
binocularity to still exist thereby preventing an increase in the percentage of time strabismic.

Adverse reactions to atropine use include mild ocular irritation and rare systemic reactions including flushing, irritability, fever, dry mouth, dry skin and tachycardia."" However, these effects have rarely been reported during clinical trials. In the studies we researched, the rate of hypersensitivity ranged from 0.5% to 1.5% of the patients.1,10,11 The reactions may be minimized by instilling the drop at night or changing from drops to ointment. Another risk with any form of occlusion therapy is reverse amblyopia. This occurs when the visual acuity in the previously dominant eye decreases below the amblyopic eye. This occurs in a very small percentage of patients, but nevertheless can be reduced by using atropine on a part time basis. Only using the drops on weekends, for example, allows the effects of the drops to wear off late in the week so the patient is allowed a period where they are not penalized in the sound eye. Some have thought that a disadvantage to atropine is that the acuity improvement arrives at a slower pace than with occlusion therapy. While this may be the case, the PEDIG study ATS1 in 2002 showed that by the end of 6 months, the difference between success rates with the two treatments was statistically insignificant.""
Binocular benefits to atropine treatment:

Simons, et al performed a retrospective study of 163 patients with strabismic amblyopia evaluating the monocular and binocular outcomes of three types of penalization. They compared optical penalization, traditional full time atropine usage and intermittent atropine (one to three times a week). One of the conclusions of the study was that each of the discussed treatment options can significantly improve mean binocularity. They remind us that pharmacologic and/or optical penalization allows each eye to be stimulated while still allowing the visual acuity to improve in the amblyopic eye. When an eye is penalized with atropine, the high-spatial frequencies are compromised but the low spatial frequency signals are preserved.\(^5,9,12\) Since the high spatial frequencies of the dominant eye, containing detail information, are suppressed, the amblyopic eye can then develop adequate neural signals without competition from the already mature signals of the sound eye. At the same time, the low spatial frequency inputs to both eyes are left intact adequately preserving binocular vision.\(^5,9\)
Patient profile for atropine usage

When deciding whether atropine is appropriate, there are a few criteria which increase the success rate with this mode of treatment. The ideal patients are anisometropes and intermittent strabismics with amblyopia. Since direct occlusion has the potential to increase the frequency of strabismus in an intermittent strabismic patient, these patients are good atropine cases. Conversely, patients with steady eccentric fixation would not be good atropine candidates, since amblyopia treatment directed at penalizing the sound eye while allowing binocular viewing would only encourage this adverse adaptation pattern in the amblyopic eye.

Another consideration for a good candidate would be acuity level in the amblyopic eye. The patient's acuity in the penalized eye should be at a level that allows fixation to switch to the amblyopic eye at near when the dominant eye is penalized. Most authors believe that when the amblyopic eye is at a level of 20/100 or better, the dominant eye is blurred sufficiently to allow fixation to switch. Therefore some practitioners that utilize atropine penalization have assumed that it would only be a viable option for patients with visual acuities in the amblyopic eye of 20/100 or better. There were, however, patients in the Simons, et al study that had visual acuity in the amblyopic eye worse than 20/100 and were successfully treated with atropine therapy. These are important considerations when thinking about beginning a regimen of atropine penalization therapy.
Combination therapy

A third option to penalize the dominant eye is to optically penalize the eye at near. This can be done by blurring the sound eye with a fogging refracting lens, density filter, Bangerter foil, or plano lens. Placing the sound eye at a sufficient disadvantage can allow fixation to switch to the amblyopic eye. On a part-time, monitored basis, atropine treatment can be combined with optical penalization to further disadvantage the dominant eye in order to aid the patient in using their amblyopic eye.¹,⁵ One study looked at the effects of combining these forms of treatment with patients who had previously failed treatment with conventional occlusion therapy. Forty-two people were treated with combined optical and atropine treatment (COAT), with a hyperopic refraction of at least 1.75 D in the sound eye. The patients had attempted occlusion for a mean of 36 weeks before commencing the study for anisometropic amblyopes, and 41 weeks for strabismic amblyopes. The mean number of hours occluded before study was 8 hours per week, only 9.5% of the prescribed amount. The mean entering visual acuity in amblyopic eye was 20/150. The rate of improvement of visual acuity was six times faster than with occlusion alone. The success rate was 76%, when defined as at least doubling the VA in the amblyopic eye, and was 45% when defined as no interocular acuity difference. Twenty of the forty-two study patients had no further treatment after COAT, and maintained their VA at 93% of post treatment acuity.'
Case reports

Case #1

Patient one is a 5 year old caucasian female who was referred to the Pediatric Strabismus Referral Center (PSRC) by a family friend (who is an O.D.) after the patient failed a pediatric eye screening. Her first eye exam was 2 weeks prior. Her ocular history was negative. Medical history was pertinent for a complicated pregnancy including induced labor due to maternal high blood pressure, liver failure, kidney failure and decreased amniotic fluid. Ocular alignment was ortho at both distance and near. Visual acuities were 20/25 OD and 20/20 OS.

Biomicroscopy revealed a grade 1-2+ posterior subcapsular cataract in the left eye. Cycloplegic retinoscopy was +2.50 OD and +7.50 – 0.50 X 180 OS. Visual acuity testing with a potential acuity meter was performed in the left eye both undilated and dilated and was found to be 20/1200. A spectacle prescription of plano sphere OD and +4.75 – 0.75 X 180 OS was prescribed. An amblyopia treatment regimen of 6 hours per day of direct occlusion combined with 30 minutes per day of home vision therapy was prescribed. Visual acuity improved to 20/150 over a period of three months, but reached a plateau staying at the 20/150 to 20/160 level. Patient regressed slightly following a bout of pneumonia to 20/70 with the whole Snellen chart, and improved with single letters to 20/150. It was believed that this was the best acuity obtainable with the cataract. The patient underwent cataract extraction, and currently her full chart visual acuity is 20/150. She is continuing her amblyopia therapy.

Case #2

Patient number two is a six year old caucasian female who was first seen in the primary care clinic of Pacific University. Ocular history was pertinent for a right eye turn, with history of patching and consideration of eye muscle surgery. She had lost her glasses and had not worn them for some time prior to our exam. The medical history was pertinent for maternal narcotic drug use during pregnancy. She presented with a constant large angle right exotropia with right hypotropia. Glasses were prescribed with powers of +6.25 -1.00 170 right eye and +4.75 sphere left eye, giving acuity of 20/1100 and 20/125 respectively. She was then referred to the PSRC where the strabismus was quantified as a constant 35 prism diopter right exotropia. On further evaluation she showed a minus three restriction of the right inferior oblique with 1+ over-action of the left superior rectus indicating a possible Brown’s Syndrome. At this visit her distance visual acuity in the right eye was 20/160 with single letters, while the left eye maintained visual acuity of 20/130 with the full chart. She showed no stereopsis with either Lang or Randot targets with superimposed 35 prism diopters of neutralizing prism. Patching four hours per day combined with active vision therapy for 45 minutes each day was prescribed at this appointment. After 2 months of patching therapy the patient's single letter Snellen acuity improved to the 20/140 to 20/150 range.
Due to compliance issues with patching the patient was started on atropine therapy with 45 minutes of vision therapy per day. Following two months of atropine treatment her distance Snellen acuity in the right eye improved to 20/40 with the full chart and a near acuity of 20/60. The left eye was 20/25 with a near acuity of 20/120. Six months later the patient underwent strabismus surgery reducing her deviation to a 6 prism diopter right exotropia at distance and a 10 prism diopter right exotropia combined with a 3 prism diopter right hypertropia at near. Following surgery the patient was able to achieve 100 arc seconds of stereopsis with wirt circles. Her final VA had regressed slightly to 20/50 whole chart snellen acuity. (Note: Patient had a very unstable home environment, not conducive to compliance.)

Case #3

Patient three is an eight year old caucasian female who was referred to Pacific University's Pediatric Strabismus Referral Center (PSRC) by her optometrist for treatment of esotropia and amblyopia in her left eye. Parents were interested in strabismus surgery. Ocular history was positive for an eye turn that was diagnosed at age 5 when she received glasses and had limited success with patching treatment. Her medical history was positive for attention deficit disorder for which the patient has taken adderall as needed. She presented with a constant 9 prism diopter left esotropia at distance and an intermittent 6 prism diopter esotropia at near. Her referring O.D. wanted to initiate patching therapy but the patient refused to wear the patch. Her habitual glasses Rx was found to be +4.50 - 1.00 X 180 OD and +5.75 -1.50 X 180 OS with a +1.75 Add OU, giving her distance acuity of 20/30 OD 20/200 OS and near acuity of 20/30 OD and 20/80 OS. Atropine penalization of the right eye was begun at this visit. At her three week follow up appointment her distance acuity in the left eye improved to 20/70 using the whole Snellen chart. After poor compliance with her active home vision therapy her visual acuity reached a plateau at the 20/70 level and did not improve over the next 6 months. Atropine therapy was discontinued at this time. Over the next six months the patient was treated with patching and home vision therapy with weekly therapy sessions. Her vision remained at the 20/70 to 20/60 level over this time period. At her appointment six months after discontinuing atropine therapy she exhibited 3 prism diopters of nasal eccentric fixation in the left eye, which would give a predicted visual acuity of 20/80. Because of continual compliance issues no active therapy to develop central fixation was started for this patient at this time.

Case #4

Patient four is a seven year old caucasian female who presented to the PSRC clinic of Pacific University with a chief complaint of the "right eye not seeing as well as the left". Problem was noted at the pediatricians and she had a complete vision exam several weeks prior to our evaluation. The patient's eye health history was unremarkable. Her family ocular history was positive for strabismus
on her father’s side. Cover testing without correction revealed a 12 prism diopter left esotropia at near and a 6-8 prism diopter left esotropia at distance. Her initial uncorrected distance visual acuity was 20/120 OD and 5/1200 OS. Dry retinoscopy showed a glasses prescription of +1.00 DS OD and +7.00 • -1.50 X 175 OS. Wet retinoscopy was +2.50 -0.25 X 170 OD 20/20 and +8.25 -2.00 X 175 with no improvement OS. A glasses prescription was written for the dry retinoscopy value and direct patching was initiated at 6 hours per day with near activities. At the one month follow-up appointment cover testing with correction showed a 4 prism diopter left esotropia at distance and a 10 prism diopter left esotropia at near. Visuoscopy showed 1-2 prism dipters of unsteady nasal eccentric fixation. Distance visual acuity in the left eye improved to 20/160 with BVAT. After three months of this direct patching regimen the patient’s percentage of time strabismic decreased. During the five months after initiating patching therapy the patient improved and plateaued at a 20/80 level in the left eye. Atropine therapy was begun with one drop every morning in the right eye, combined with one hour of daily vision therapy. Over the next two weeks her distance visual acuity improved to 20/160 and remained plateaued at that level for the next five months.

Summary of case studies

All cases benefited both in improvement in visual functioning, and in compliance with the "penalization" portion of the therapy. It is still a challenge to engage some of these young patients in the active home therapy techniques that appear important in hastening visual function improvement. While the above patients did not reach a final acuity level of 20/120 OU, each had unique challenges that limited the final potential visual acuity.

Case one had improved to the limits of her cataract, and continues to improve now that it has been removed. Case two improved 50%. Case three improved to approximately three times better acuity, even with eccentric fixation and a compliance problem that did not permit home therapy. Case four improved from 20/800 equivalent to 20/160, approximately four times better acuity.
Cost Comparison

Studies, which compare the cost to the patient of using atropine or patching as a treatment option, indicate that cost is a mute point. In 2002, the Pediatric Eye Disease Investigator Group (PEDIG) found that assuming the cost of a patch to be approximately $0.35 and the cost of a 15ml bottle of atropine to be $10, patching for six months would cost about $100 and using drops daily for six months would cost $10.10 Adding in the cost of possible lens changes to optically penalize the atropinized eye, this still makes atropine a slightly more economical option. However, one editorial indicated that if the patient needed to continue one more visit past six months, they become approximately equal.15
**Amblyopia Treatment Studies**

PEDIG has developed a series of studies that test the relative effectiveness of currently used amblyopia treatments. The Amblyopia Treatment Study 1 (ATS 1) found that both patching and atropine therapies were effective treatments for moderate amblyopia in children 3-7 years old. It was found in ATS 1 that the six-month acuity had improved from baseline by 3 or more lines in 79% of the subjects in the patched group and 74% for the atropine group. "In summary, both atropine and patching are effective treatments for moderate amblyopia (in the tested age group)." Patching showed a slightly more rapid improvement than atropine. Perhaps if they had used optical penalization therapy for the hyperopes earlier in the study, the two methods would have been closer in treatment duration. Atropine does, however, have the advantage of ease of administration, better cosmesis and compliance better during treatment. In ATS 1 the researchers administered one drop of atropine everyday. Since the cycloplegia effect lasts much longer than one day, studies are attempting to further define the minimum application time for atropine to obtain maximum effect.
Conclusion:

While many options exist, the majority of eye care practitioners historically have treated amblyopia with some form of occlusion therapy. In an unpublished study in 1997, practicing pediatric ophthalmologists were surveyed as to what treatment they used for amblyopia treatment. Ninety seven percent reported using occlusion therapy as their initial treatment. Several studies have indicated that atropine penalization is an effective primary treatment for mild to moderate levels of strabismic amblyopia. Simons, et al point out that atropine is not simply a fall back method for "use with occlusion failures or for post-ocular acuity maintenance." Due to this evidence and other recent studies, the decision of which penalization method to use can now depend primarily on what is practical for a given patient.

Patching offers a safe, non-pharmaceutical, complete occlusion, which allows the doctor the flexibility to alter the treatment dose depending on the patient profile. Part-time, full-time, or alternating occlusion can be easily maintained with a patch that begins effectivity upon placement, and ends effectivity when removed. Patients who would benefit from patching would be those who have acuity in the amblyopic eye less than 20/100. Those who are constant strabismics will benefit from patching by breaking down any pattern of suppression and allowing the amblyopic eye to fully develop.

Atropine penalization offers the doctor and patient another treatment option with equal efficacy, but also several benefits. Most importantly, there is a potential for increased compliance. For anisometropic amblyopes and amblyopic patients whose constant strabismus is now intermittent, atropine maintains a protective level of binocularity as opposed to full occlusion with patching. Atropine can therefore prevent an
increase in strabismus in a patient with a fragile binocular system. Atropine therapy also
offers less emotional trauma and familial strife to persistent children who continually
refuse to wear the patch. Atropine does not irritate the skin, nor require constant parental
supervision to assure compliance. In active children, atropine will not "come off" as
patches do when the skin becomes warm. All of these subtle differences lead to an
increased compliance rate for many patients. While both options can be used in most
cases, knowing that the outcomes are statistically equal allows us to tailor our treatment
method and duration to assure the best compliance. This increased compliance provides
the most rapid improvement in visual acuity, as well as providing optimal patient and
parent satisfaction.

Current ongoing studies by PEDIG will examine other aspects of atropine
penalization such as intermittent use. There is a study comparing weekend only versus
daily atropine instillation to determine the duration of efficacy as well as to assess the
effects of allowing the patients to have some time to use binocular vision while the
previous drops are no longer effective. Another current study assesses amblyopia
treatment in children older than 7 years of age. There are always new studies that will
allow us to further understand amblyopia. It is important to constantly look for recent
evidence of effective patient management, and be amenable to altering the treatment
plans according to current information and evidence. Atropine offers equal results with
improved patient and parent satisfaction and fewer confrontations ultimately leading to
better compliance. This is clinically quite powerful.


