COVD COLLEGE OF OPTOMETRISTS IN VISION DEVELOPMENT

A SUMMARY OF RESEARCH AND CLINICAL STUDIES ON OPTOMETRIC VISION THERAPY

Optometric vision therapy, also referred to as visual training or orthoptics, is an individualized program of therapeutic and rehabilitative procedures prescribed to provide treatment for diagnosed visual dysfunctions. Vision therapy involves participation of the patient in a sequence of specific controlled visual tasks or procedures that modify visual function. The therapeutic application of lenses, prisms, filters, occlusion and specialized equipment is used in conjunction with the therapy procedures to help bring about improvement in vision.

Optometric vision therapy has been shown to be an effective treatment for many types of vision problems. A listing and summary of some of the research reports and clinical studies on the use and effectiveness of vision therapy is provided on the following pages.

Vision therapy is a specialized area of optometric care. The following Optometric Clinical Practice Guidelines include a description of the current clinically recognized and supported approaches to the diagnosis and treatment of vision problems utilizing optometric vision therapy:

- Care of the Patient with Accommodative and Vergence Dysfunction. St. Louis: American Optometric Association, March 20, 1998.
- Care of the Patient with Amblyopia. St. Louis: American Optometric Association, June 20, 1994.
- Care of the Patient with Strabismus: Esotropia and Exotropia. St. Louis: American Optometric Association, June 20, 1995.

Complete copies of these Guidelines can be accessed on the American Optometric Association web site at www.aoanet.org.

Other web site resources include:

- College of Optometrists in Vision Development www.covd.org
- Optometric Extension Program Foundation www.oep.org

Copies of the complete text of any of the articles listed can be obtained from:

International Library, Archives and Museum of Optometry
243 N. Lindbergh Blvd. St. Louis, MO 63141
800/365-2219 x 104

Accommodative Dysfunctions ICD-9-CM 367.53
(Eye Focusing)

Bobier WR, Sivak JG. Orthoptic treatment of subjects showing slow accommodative responses. Am J Optom & Physiol Optics, 60 (8): 678-687, 1983.

Five subjects showing slow accommodative responses were given orthoptic treatment. Speed of accommodative response improved after 3 to 6 weeks of treatment. No regressions were evident 18 weeks after the cessation of training.

Cooper J, Feldman J, Selenow A, et. al. Reduction of asthenopia after accommodative facility training. Am J Optom & Physiol Optics, 64 (6): 430-436, 1987.

Five patients reporting asthenopia secondary to accommodative deficiencies underwent automated accommodative facility training. A matched-subjects, crossover design was used to control for placebo effects. All patients receiving automated accommodative training showed a marked increase in accommodative amplitude along with a concurrent reduction of asthenopia. Decreases of blur and increased reading time were the most frequently reported changes by patients. This study showed the effectiveness of automated accommodative training in reducing asthenopia and improving accommodative facility.

Daum KM. Accommodative insufficiency. Am J Optom & Physiol Optics, 60(5): 352-359, 1983.

A review of the records of 96 patients with accommodative insufficiency was conducted. In addition to reduced accommodative amplitude for their ages, a reduction in the facility of accommodation, a smaller lag of accommodation, a tendency toward convergence insufficiency, slightly reduced fusional vergence and stereopsis, and a reduced nearpoint of convergence were found. The results of orthoptic exercises and/or a plus lens addition at near were examined. Most patients (90%) obtained some relief with treatment. About 53% had their objective and subjective problems totally solved during and average treatment period of 3.7 weeks.

Hung GK, Ciuffreda. KJ, Semmlow JL. Static vergence and accommodation and orthoptics effects. Doc Ophthalmol, 62: 165-179, 1986.

This study evaluated changes in vergence and accommodative systems in two populations: 22 visually-normal asymptomatic individuals and 21 visually-abnormal symptomatic individuals before and after conventional orthoptic therapy. Symptomatic subjects were placed into one of three training groups depending on clinical abnormalities and symptoms. The training period ranged from 8 to 16 weeks. Long term follow-up testing was performed 6 to 9 months after the training ended.

Symptomatic individuals showed a shift toward the mean of visually-normal asymptomatic subjects following training. The long term results showed a maintenance of the initial post-training improvement. The efficacy of orthoptic treatment was indicated by a large reduction in overall symptom rating level.

Liu JS, Lee M, Jang J, et. al. Objective assessment of accommodation orthoptics. I. Dynamic insufficiency. Am J Optom & Physiol Optics, 56 (5): 285-294, 1979.

Three young adult females with symptoms related to focusing difficulties at near were treated by standard orthoptic (vision therapy) procedures. Home training was done 20 minutes each day for 4 ½ to 7 weeks. Objective measures of dynamic accommodation were made each week. During treatment, the patients showed significant reductions in time constants and latencies of accommodation. That correlated well with elimination of subjective symptoms. Also, in all three patients, symptoms were either markedly diminished or no longer present at termination of therapy. These results clearly demonstrate that orthoptic treatment in three adult patients resulted in objective improvement of accommodation function.

Rouse MW. Management of binocular anomalies: Efficacy of vision therapy in the treatment of accommodative deficiencies. Am J Optom & Physiol Optics, 64 (6): 415-420, 1987.

This paper is a review of the literature supporting vision therapy as an effective treatment mode for accommodative deficiencies. Vision therapy procedures have been shown to improve accommodative function effectively and eliminate or reduce associated symptoms. In addition, the actual physiological accommodative response variables modified by the therapy have been identified, eliminating the possibility of Hawthorne or placebo effects accounting for treatment success. Finally, the improved accommodative function appears to be fairly durable after treatment.

Sterner B, Abrahamsson M, Sjostrom A. Accommodative facility training with a long term follow up in a sample of school aged children showing accommodative dysfunction. Doc Ophthalmol 99:93-101, 1999.

The purpose of this study was to evaluate the effect of accommodative training in a group of children with accommodative dysfunction and subjective symptoms. A total of 38 symptomatic children (ages nine to thirteen) and 24 controls, participated in the study. The length of training varied from 3 to 25 weeks. A follow-up examination was performed two years after the end of training.

The study showed that it is possible to increase relative accommodative by accommodative facility training and minimize subjective symptoms. In the followup evaluation, none of the children had regained any subjective symptoms.

Suchoff IB, Petito GT. The efficacy of visual therapy: accommodative disorders and non-strabismic anomalies of binocular vision. J Am Optom Assoc, 57 (2): 119-125, 1986.

This paper examines the available literature in order to answer the question, "Is there evidence that 'orthoptics' or 'vision therapy' causes changes in an individual's accommodative or vergence eye movement systems?" The literature cited substantiates that visual therapy can modify visual functions and also points out the relationship of these changes to the relief of certain symptoms.

Weisz CL. Clinical therapy for accommodative responses: Transfer effects upon performance. J Am Opt Assn, 50 (2): 209, 1979.

A clinical therapy program featuring accommodative training was administered to a group of children with diagnosed disorders of accommodative function. The children ranged in age from six to twelve years. A group of subjects representing the same clinical population, and not differing significantly in age or grade level, acted as a control group. The control subjects participated in a therapy program of a similar duration, wherein perceptual-motor training (unrelated to the training of accommodative skills) was administered. A nearpoint pencil-and-paper task was administered to all subjects before and after the training programs, to assess changes in performance as criterion of learning transfer and behavioral generalization. A significantly greater decrease in errors occurred in the group receiving the accommodative training as contrasted to the control group. No significant differences were found in the time scores. The results suggest that accommodative training for children with diagnosed accommodative disorders, had transfer effects upon nearpoint performance relating to improved accuracy.

Vergence Anomalies ICD-9-CM 378.83, 378.84
(Eye Coordination)

Birnbaum MH, Cohen AH. Efficacy of vision therapy for convergence insufficiency in an adult male population. J Am Optom Assoc, 70 (4): 225-32, 1999.

Sixty adult males over the age of 40 years with convergence insufficiency were divided into three treatment groups: Office-based vision therapy with supplementary home therapy, home therapy only, and a control group. Therapy was provided over a 24 week period. Vision therapy was successful in 61.9% of patients who received in-office plus home therapy and 30% of patients who received home therapy only. Vision therapy was found to be effective in eliminating asthenopia and improving convergence function in adult patients.

Cohen AH, Soden R. Effectiveness of visual therapy for convergence insufficiencies for an adult population. J Am Optom Assoc, 55(70): 491-494, 1984.

Visual therapy is an effective treatment modality for convergence anomalies. Complaints of blurred vision, diplopia, headaches, and asthenopia associated with convergence insufficiencies can be alleviated for most patients regardless of age. Once the basic reflexes of convergence are established, there seems to be a high level of long-term success.

Cooper J, Selenow A, et. al. Reduction of asthenopia in patients with convergence insufficiency after fusional vergence training. Am J Optom & Physiol Optics, 60(12): 982-989, 1983.

Seven patients with convergence insufficiency and related asthenopia underwent automated fusional convergence training. A matched subjects control group crossover design was used to reduce placebo effects. All patients showed significant increases in vergence ranges with concurrent marked reduction of symptoms after training. Results demonstrated the effectiveness of fusional vergence training in reducing asthenopia in these patients. Subsequent accommodation and vergence training using traditional orthoptic procedures yielded further reduction of asthenopia, as well as an increase in the base-out fusional range.

Daum KM. Convergence insufficiency. Am J Optom & Physiol Optics, 61 (1): 16-22, 1984.

A retrospective study of 110 subjects with convergence insufficiency was completed. Their mean age was 19.9 years. There were 72 females and 38 males in the group. The clinical profiles of these subjects were examined before and after a standard orthoptic treatment regimen. Over the course of treatment, the near angle of deviation, the AC/A ratio, a portion of the negative vergence values,

the nearpoint of convergence, and the amplitude of accommodation were found to have changed in a statistically significant manner.

Daum KM. The course and effect of visual training on the vergence system. Am J Optom & Physiol Optics, 59(3): 223-227, 1982.

The effect of a variety of vergence training procedures on the visual system of 35 asymptomatic young adults with normal binocularity was evaluated. Vergence ranges were measured before the study began and at the end of the three week period. Subpopulations were evaluated at one week and at six months to document further the course of the effects. Positive fusional vergence training significantly increased the vergence ranges after one week of training; a greater effect was measured after three weeks. The vergence capability was found to have decreased six months later, but the effects of the training were still apparent. Negative fusional vergence training was less effective; however, significant increases were demonstrable after three weeks of training. Relatively short periods of training can provide long-lasting increases in the vergence ability of a group of binocular normals.

Daum K. Double-blind placebo-controlled examination of timing effects in the training of positive vergences. Am J Optom & Physiol Optics, 63(10): 807-812, 1986.

The purpose of this study was to document the effects of positive fusional vergence therapy and to determine the most effective timing of such training. Four experimental protocols were selected and five subjects were assigned randomly to each of the four experimental groups. Each subject in each group spent 120 min. (total) over a period of three weeks doing positive fusional vergence training. Group A trained in twelve 10-min, sessions; group B in six 20-min. sessions; and group C in three 40-min, sessions. Group D was a control group. All the training was in-office and consisted of positive fusional vergence training on the synoptophore. Each of the test groups showed increases in their positive fusional vergence ability at both distance and near. Group A (shorter sessions) demonstrated the largest increases overall. In addition, the group which trained in short 10-min sessions (Group A) was the only one which showed significant increases in the negative fusional vergences and the positive blur finding.

Daum KM, Rutstein RP, Eskridge JB. Efficacy of computerized vergence therapy. Am J Optom & Physiol Optics, 64 (2): 83-89, 1987.

The purpose of this study was to determine the efficacy of computerized fusional vergence therapy and the effect of two different vergence training velocities. Six subjects received positive vergence training using a slow vergence training rate (0.75/s) and six subjects received positive vergence training using a fast vergence

training rate (5.00/s). Six subjects served as controls and did not receive therapy. The duration of therapy was 80 min over a period of four weeks. All training activities were monitored. All vergence evaluations were double masked. Subjects using a slow training rate showed significant increases in positive vergence ranges as measured with the major amblyoscope, whereas subjects training with fast rates did not. We conclude that vergence therapy using a computerized video display is an effective technique for increasing the amplitudes of positive fusional vergence and that slower rates are more productive than faster rates.

Daum KM, Rutstein RP, et. al. Horizontal and vertical vergence training and its effect on vergences and fixation disparity curves: I. Horizontal data. Am J Optom & Physiol Optics, 65 (1): 1-7, 1988.

The purpose of this study was to assess the effects of horizontal and vertical vergence training on fusional vergences and the fixation disparity (FD) curve. Thirty-four subjects were divided into three groups. One-third served as controls and the other two-thirds underwent five hours of supervised horizontal and vertical vergence training, respectively. Before and after the 4 week training period, vergences and FD curves were measured by a single individual who was intentionally uniformed of each subject's group. Analysis revealed that the positive vergences increased significantly for those in the horizontal group. No evidence was found to suggest changes in any variables related to the FD curve.

Daum KM. Negative vergence training in humans. Am J Optom & Physiol Optics, 63 (7): 487-496, 1986.

Two healthy subjects (male and female, ages 22 and 25 years) spent 50 hours over a period of 7 consecutive weeks training the negative vergence system. The training was performed in two 45-min daily sessions, usually immediately before and after the workday. The training was exclusively negative vergence training using devices such as variable vectograms, the aperture rule, the synoptophore, and loose or bar prisms. An extensive examination of the visual systems before , after and periodically during the training demonstrated that the negative vergences increased at distance by 5.0 and at near by 9.1 (using hand-held prisms, bar prisms, and the synoptophore). The phorias of both subjects became more exophoric or less esophoric at both distance and near by 3.6 (using average of changes on the cover test, von Graefe subjective phoria technique, and the synoptophore). Other testing suggested that the negative relative accommodation, the angle of deviation at both distance and near, positive vergences, the associated phoria, and the slope of the fixation disparity curve changed significantly over the period of training. Negative vergence training can increase the negative vergence capabilities and also affect the phoria position of the eyes via feedback into the slow vergence system.

Ficarra AP, Berman JB, Rosenfield M, Portello JK. Vision training: predictive factors for success in visual therapy for patients with convergence excess. J Optom Vision Dev 27 (4): 213-219, 1996.

A retrospective study was conducted of 31 patients who had received vision therapy for convergence excess. The mean number of training sessions was 19. Vision therapy produced a significant reduction in symptoms of both distance blur and headaches. Prior to treatment, 55% of the patients experienced headaches related to near work; following therapy only 2 patients reported headaches. Before receiving vision therapy, 41% of the patients reported transient visual blur; after therapy only 3 patients still reported experiencing this symptom.

Gallaway M, Scheiman M. The efficacy of vision therapy for convergence excess. J Am Optom Assoc 68(2): 81-86, 1997.

The records of 83 consecutive patients with convergence excess who were treated with vision therapy were reviewed to assess the impact of treatment on clinical findings and patients symptoms. Statistically and clinically significant changes in direct and indirect measures of negative fusional vergence resulted from vision therapy, with 84% of patients reporting a total elimination of initial symptoms. Vision therapy was successful in enhancing negative fusional vergence and eliminating symptoms in the vast majority of patients.

Griffin JR. Efficacy of vision therapy for nonstrabismic vergence anomalies. Am J Optom & Physiol Optics, 64 (6): 411-414, 1987.

A review of the literature published in the past 15 years was carried out to determine the effect of visual training on vergence measurements for nonstrabismic patients. Results of cited studies are summarized.

Grisham JD. Visual therapy results for convergence insufficiency: A literature review. Am J Optom & Physiol Optics, 65 (6): 448-454, 1988.

This paper is a review of the literature relative to treatment results for convergence insufficiency utilizing vision therapy training procedures. Vision therapy is known to improve the nearpoint of convergence and fusional convergence and to ameliorate associated symptoms. The overall cure rate is 72%. Furthermore, the training results appear to persist for at least 2 years if the patients are initially cured and are independent of age until the late presbyopic years. Also, recent studies indicate the type of training procedures which yield the most effective training results.

Grisham JD, Bowman MC, et. al. Vergence orthoptics: validity and persistence of the training effect. Optom & Vis Sci, 68 (6): 441-451, 1991.

The relation between Risley prism vergences, a subjective measure, and vergence tracking rate, an objective index, is investigated. The course of orthoptics progress is compared in cases of clinical vergence dysfunction. Vergence-deficient control subjects showed no significant change in either index. However, trained subjects demonstrated rapid increases in both indices. The persistence of the training effect was monitored for up to nine months. No regression was observed in subjects who met all release criteria, but one subject who chose to terminate therapy early showed a slow regression in tracking rate and recurrence of symptom. These data support the validity of vergence training and increase the plausibility of previous clinical reports of orthoptics success.

Hung GK, Ciuffreda KJ, Semmlow JL. Static vergence and accommodation and orthoptics effects. Doc Ophthalmol, 62: 165-179, 1986.

This study evaluated changes in vergence and accommodative systems in two populations: 22 visually-normal asymptomatic individuals and 21 visually-abnormal symptomatic individuals before and after conventional orthoptic therapy. Symptomatic subjects were placed into one of three training groups depending on clinical abnormalities and symptoms. The training period ranged from 8 to 16 weeks: Long term follow-up testing was performed 6 to 9 months after training ended.

Symptomatic individuals showed a shift toward the mean of visually-normal asymptomatic subjects following training. The long term results showed a maintenance of the initial post-training improvement. The efficacy of orthoptic treatment was indicated by a large reduction in overall symptom rating level.

Luu CD, Green JF, Abel L. Vertical fixation disparity curve and the effects of vergence training in a normal young adult population. Optom Vis Sci, 77: 663-69, 2000.

Forty-five subjects with normal vision and binocular function underwent vertical vergence training for one week. The control group consisted of 34 subjects. Vertical prism bar training provided a long-term effect, both increasing the vertical fusional amplitude and flattening the slope of the vertical fixation disparity curve.

North RV, Henson DB. The effect of orthoptic treatment upon the vergence adaptation mechanism. Optom &Vis Sci, 69(4): 294-299, 1992.

This paper is a review of the research work that has been carried out over the past few years investigating the ability of the oculomotor system to adapt to prism-induced heterophoria. The results show that subjects with normal binocular vision

can adapt to horizontal and vertical prisim-induced heterophorias whether fixating at distance or near. Further studies have shown that subjects with symptomatic abnormal binocular vision have an abnormal adaptation mechanism. Finally, we have found that when orthoptic treatment results in relief from the symptoms, there is an associated improvement in these subjects' ability to adapt to prism-induced heterophoria.

Passmore JW, Maclean F. Convergence insufficiency and its management. Am J Ophthal, 43: 448-56, 1957.

This study reported on the evaluation of 100 patients receiving a course of orthoptics for the treatment of convergence insufficiency. The average patient age was 24, range of 8 to 42 years of age. Orthoptic treatment averaged seven sessions of 30 minutes each. A total of 82 patients received complete relief of subjective symptoms at the end of treatment and 18 received partial relief.

Shorter AD, Hatch SW. Vision therapy for convergence excess. N Engl J Optom, 45(2): 51-53, 1993.

This paper is a retrospective study of symptomatic patients with diagnosis of convergence excess who received vision therapy. In a sample of 12 nonpresbyopic subjects, 8 (66%) reported significant improvements in symptoms. Of 8 records where pre and post-treatment base in vergence ranges were available, 5 (63%) showed improvement, but this improvement was not statistically significant.

Amblyopia ICD-9-CM 368.01, 368.02
(Lazy Eye)

Birnbaum MH, Koslowe K, Sanet R. Success in amblyopia therapy as a function of age: A literature survey. Am J Optom & Physiol Optics, 54(5): 269-275, 1977.

It is frequently stated that amblyopia is not correctable after the age of 6 years. However, many practitioners report marked success for older patients. To evaluate these conflicting reports, this study analyzed the results from 23 published amblyopia studies. The analysis indicates that substantial numbers of patients over age six were successfully treated. Success rates under age 6 were not significantly better than those in older patients when the criterion for success was achievement of 20/30 acuity or better. When a criterion of 4 lines improvement was used, success rates at all ages under 16 were quite similar; in patients 16 and over, success by this criterion was significantly less frequent, but even in this group success was achieved by 42% of the patients.

Cotter SA. Conventional therapy for amblyopia. A chapter in Problems in Optometry, RP Rustein (ed), 3(2): 312, 1991.

Conventional treatment of amblyopia involves appropriate refractive correction, occlusion of the dominant eye, and active vision therapy. The specific occlusion regimen is determined based on the patient's age, binocular status, acuity level, and performance needs. Successful amblyopia treatment is dependent on several factors, of which patient compliance is the most important. There is no evidence that treatment should be with held on the basis of age. Close follow-up is essential and maintenance therapy is often necessary.

Garzia RP. Efficacy of vision therapy in amblyopia: A literature review. Am J Optom & Physiol, 64(6): 393-404, 1987.

In this paper the major optometric, ophthalmologic, and orthoptic literature on the efficacy of vision therapy for amblyopia was surveyed. Over the past four decades there are many examples of the successful treatment of amblyopia in the form of well documented individual case reports or large sample studies. Although occlusion of the dominant eye has been applied universally, there are some instances of the successful use of minimal occlusion combined with extensive visual-motor therapy. Overall, the results of the literature review strongly support the use for active vision therapy as an integral part of the clinical treatment of amblyopia.

Hokoda SC, Ciuffreda KJ. Different rates and amounts of vision function recovery during orthoptic therapy in an older strabismic amblyope. Ophthal & Physiol Opt, 6(2): 213-220, 1986.

Orthoptic therapy was instituted in an 11-year-old patient having deep amblyopia, a constant small-angle esotropia with anomalous retinal correspondence, and a past history of minimal success with such therapy. This combination of factors pointed toward a poor prognosis for substantial recovery of vision functions. Rate of recovery of several monocular and binocular vision functions was monitored during the course of 18 months of intensive orthoptic therapy. Results showed marked improvement in several monocular vision functions, suggesting presence of considerable residual neural plasticity of multiple sites in the visual pathways of this older patient with amblyopia.

Koskela PU, Mikkola T, Laatikainen L. Permanent results of pleoptic treatment. ACTA Ophthalmologica, 69: 39-44, 1991.

The value of pleoptic treatment was assessed by long-term follow-up of patients treated 15-22 years ago, employing a questionnaire sent of 232 patients and a clinical examination of a sample of 44 of these. Answers were received from 157 persons with different occupations and educational levels. The poorest results were found in the combined strabismic and anisometropic amblyopia group. The final VA correlated positively with the initial VA and negatively with age at the time of treatment. Binocular single vision improved the prognosis. Altogether ¼ of the patients achieved a VA of 1.0 or better, about one half experienced no permanent increase in VA and the remainder were distributed evenly between these two extremes.

Krumholtz I, FitzGerald D. Efficacy of treatment modalities in refractive amblyopia. J am Optom Assoc, 70(6):399-404, 1999.

A retrospective review was performed of 78 patients diagnosed with refractive amblyopia. Each patient's progress was tracked for a period of 6 months. Treatment alternatives were optical correction alone, optical correction in conjunction with patching, and optical correction and patching with vision therapy. The groups that patched with correction and those that received vision therapy had similar visual activity improvements; however, the latter group had a significantly greater improvement in stereopsis. Though patching alone may be sufficient for improvement of visual activity, binocular performance is significantly better when vision therapy is included in the treatment regimen.

Rutstein RP, Fuhr PS. Efficacy and stability of amblyopia therapy. Optom & Vis Sci, 69(1): 747-754, 1992.

To determine the efficacy and stability of therapy, the charts for 64 amblyopes with strabismus and /or anisometropia who had been treated by direct occlusion were reviewed. For patients aged 7 years or less (N=39), 90% showed some acuity gain, with 69% achieving at least a doubling of acuity. Fifty-four percent obtained 20/40 or better after an average treatment period of 3.8 months. Some reduction in visual acuity (VA) subsequently occurred for 75% of those patients followed. For patients aged eight years or more (N=26), 77% showed some acuity gain with 31% (8/260 improving at least 0.3 log units. Twenty-seven percent obtained 20/40 (6/12) or better after an average treatment period of 4.2 months, although no patients older than 10 years (N=13) achieved 20/40 . Loss of some of the acuity gain subsequently occurred for 67% of those followed. These findings indicate that VA can be improved by patching therapy in most patients older than 7 years, but the acuity improvement is somewhat less than in younger patients. At least 67% of all amblyopes followed for one year lost some of the acuity gain after cessation of therapy, regardless of the age when treated. As a reduction of the acuity gain is likely to occur within the first year after cessation of therapy, it is recommended that amblyopic patients of all ages be followed at regular intervals.

Saulles H. Treatment of refractive amblyopia in adults. J Amer Optom Assoc, 58(12): 959-960, 1987.

Treatment of amblyopia has been relatively ignored in the adult population. In a retrospective study at the University of Michigan Health Service, 10 patients with refractive amblyopia showed visual acuity improvement in their amblyopic eye after completing simple vision therapies.

Selenow A, Ciuffreda KJ. Vision function recovery during orthoptic therapy in an adult esotropic amblyope. J Amer Optom Assoc, 57(2); 132-140, 1986.

Orthoptic therapy was instituted in a 29-year-old patient having moderate amblyopia, constant small-angle esotropia, and large and steady eccentric fixation. This combination of factors, especially the age, pointed toward a poor prognosis for attainment of markedly improved vision function. Rate of recovery of several monocular vision functions was monitored during one year of orthopic therapy. Results showed substantial improvement in most areas, thus providing evidence of neural plasticity at multiple sites in the visual pathways in this adult amblyope.

Selenow A, Ciuffreda KJ. Vision function recovery during orthoptic therapy in an exotropic amblyope with high unilateral myopia. Am J Optom & Physiol Optics, 60(8): 659-666, 1983.

Orthoptic therapy was instituted in a 6 ½-year-old patient having deep amblyopia, constant exotropia, and high unilateral myopia. The combination of these factors pointed toward poor prognosis for attainment of normal monocular and binocular vision function. Rates of recovery of several vision functions were monitored during orthoptic therapy. Results showed marked improvement in most areas, thus providing evidence of neural plasticity at multiple sites in the visual pathways.

Wick B, Wingard M, et. Al. Anisometropic amblyopia: Is the patient ever too old to treat? Optom & Vis Sci, 69(11): 866-878, 1992.

This report describes a sequential management program for anisometropic amblyopia that consists of four steps: (1) the full refractive correction, (2) added lenses or prism when needed to improve alignment of the visual axes, (3) 2 to 5 hour/day of direct occlusion and (4) active vision therapy to develop monocular acuity and improve binocular visual function. The records of 19 patients over six years of age who had been treated using this sequential management philosophy were evaluated. After 15.2 weeks of treatment the Amblyopia Success Index (ASI) documented an average improvement in visual acuity of 92.1% with a range from a low of 75% by a 49-year-old patient to a maximum of 100% achieved by 42.1% of the patients (8 of 19). Patients who had completed therapy one or more years ago (N=4) maintained their acuity improvement. From these results, we conclude that following a sequential management plan for treatment of anisometropic amblyopia can yield substantial long-lasting improvement in visual acuity and binocular function for patients of any age.

Strabismus
ICD-9-CM 378.01, 378.05, 378.11, 378.15, 378.21, 378.22, 378.23, 378.24, 378.35
(Crossed eyes)

Caloroso EE. A sequential strategy for achieving functional binocularity in strabismus. J Amer Optom Assoc, 50(5): 378, 1998.

The clinical approach to achieving functional binocularity for constant strabismus includes a series of sequential steps utilizing several therapy options. Passive therapy includes lenses, prisms, filters, occlusion, medications and strabismus sugery. Active therapy adds visual exercises and/or self-monitoring systems such as biofeedback. Consideration of commonly used options and an overall sequential strategy is presented as a practical guide to the successful management of strabismic patients.

Chryssanthou G. Orthoptic management of intermittent exotropia. Am Orthoptic J, 24:69-72, 1974.

This study reviewed the cases of 27 patients with intermittent exotropia (ages 5 to 33 years) who received orthoptic treatment. A total of 89% of patients showed definite improvement, with 66.6% graded excellent or good 6 months to 2 ½ years after termination of orthoptic treatment.

Coffey B, Wick B, et. al. Treatment options in intermittent exotropia: A critical appraisal. Optom & Vis Sci, 69(5): 386-404, 1992.

This paper reviews the clinical literature related to five different treatment modalities used for intermittent exotropia (IXT): Overminus lens therapy, prism therapy, occlusion therapy, extraocular muscle surgery, and vision therapy. Based upon review of 59 studies of treatment of IXT, and using each author's stated criteria for success, the following pooled success rates were revealed: Overminus lens therapy (N=215), 28%; prism therapy (N=201), 28%; occlusion therapy (N=170), 37%; extraocular muscle surgery (N=2530), 46%; and orthoptic vision therapy (N=740), 59%. Success rates for IXT surgery differed depending upon whether a functional (43%) or cosmetic (61%) criterion was used to evaluate treatment success.

Cooper J, Medow N. Intermittent exotropia basic and divergence excess type. Binocular Vis & Eye Muscle Surg, 8(3): 185-216, 1993.

Intermittent exotropia is a unique strabismus with a specific set of sensory motor findings. This paper provides a comprehensive review of nomenclature, epidemiology, sensory motor findings, theories of etiology, and treatment of intermittent exotropia, of both basic and divergence excess types.

Cooper J. Orthoptic treatment of vertical deviations. J Amer Optom Assoc, 59(6): 463-468, 1988.

Four patients with large vertical deviations were treated with a combination of prismatic glasses and orthoptics. The least amount of prism which eliminated diplopia, followed by horizontal fusional range extension, was prescribed. After vergences were normalized, the prism was further reduced by two prism diopters and horizontal fusional range extension was repeated. This process was repeated until either a plateau was achieved or the prism was eliminated. All four patients completed therapy with almost total alleviation of symptoms and elimination of full-time prismatic correction

Duckman RH. Management of binocular anomalies: Efficacy of vision therapy, exotropia. Am J Optom & Physiol Optics, 64(6): 421-429, 1987.

This paper presents a survey of the literature on management of the various forms of exotropia. Criteria for success of treatment are examined. A table summarizing the results of 11 studies is given.

Flax, N. A comparison of functional results in intermittent divergent strabismus treated surgically and optometrically. J Opt Vis Devel, 17(4): 18-19, 1986.

The literature was reviewed to determine functional outcomes when intermittent exotropia is treated surgically. Twenty-two papers were analyzed in terms of binocular function. The results achieved surgically are compared and contrasted with published results when strabismus is treated with orthoptics. The data indicated that vision therapy is more successful than surgery for intermittent exotropia from both a functional and cosmetic standpoint.

Flax N, Duckman RH. Orthoptic treatment of strabismus. J Amer Optom Assoc, 49(12): 1353-1361, 1978.

The purpose of this paper was to carefully examine the effectiveness of orthoptics as a viable treatment modality for strabismus. A review of pertinent literature and an analysis of the data was presented. The training of the optometrist in orthoptics and associated subjects was examined to demonstrate the qualification of the optometrist to administer orthoptics in the treatment of visual anomalies.

Gallaway M, Vaxmonsky T, Scheiman M. Management of intermittent extropia using a combination of vision therapy and surgery. J Amer Optom Assoc, 60(6): 428, 1989.

Vision therapy has been shown to provide higher success rates than surgery in the treatment of intermittent exotropia, but vision therapy is not successful in all cases. A case of intermittent exotropia is presented that illustrates the use of

vision therapy in combination with surgery. Issues that should be considered when selecting this treatment option are discussed.

Goldrich SG. Optometric therapy of divergence excess strabismus. Am J Optom & Physiol Optics, 57(1): 7-14, 1980.

A review and analysis of the vision training procedures were carried out over a period of 2 years at State University of New York (SUNY) University Optometric Center by 20 staff optometrists on 28 patients exhibiting divergence excess strabismus. Training included motility, accommodative rock, fusion, antisuppression, and stereoscopic skills by a variety of techniques and devices. Patients who exhibited smaller pre-training angles of deviation, increased maturity, and greater motivation responded most successfully to treatment. The results achieved in this study compare favorably with those obtained by traditional orthoptic procedures.

Kran BS, Duckman R. Divergence excess exotropia. J Amer Optom Assoc, 58(11): 921-930, 1987.

This paper presents a summary of information regarding divergence excess exotropia. This paper deals with the description (i.e. definition, onset, natural history, prevalence, sexual distribution, symptomatology, and the differential diagnosis of the two (subtypes) of this entity and reviews the various treatment options (surgery, lens therapy, prism therapy, and vision training) currently available with emphasis on vision training/orthoptics. It was concluded that divergence excess exotropia is effectively managed at least as well as by vision training/orthoptics as it is by surgery.

Pritchard C, Ellis GS. Management of intermittent exotropia: For non-surgical therapy. Am Orthoptic J, 48: 21-24, 1998.

This article reviews the nonsurgical treatment for intermittent exotropia. Intermittent exotropia is a condition involving both sensory and motor defects. To enhance results of surgical treatment of the motor defect, nonsurgical techniques can be applied to treat the sensory defect. The available nonsurgical techniques (orthoptics) are numerous, as are the applications. The techniques can be applied when surgery is not indicated or when surgery is delayed. They can also be applied pre- or postoperatively to improve surgical success rate.

Sanfilippo S, Clahane A. The effectiveness of orthoptics alone in selected cases of exodeviation: The immediate results and several years later. Am Orthoptic J 20: 104-117, 1970.

This study reviewed the effectiveness of basic orthoptic procedures in the treatment of exodeviation in 31 patients. Orthoptic sessions ranged from 5 to 22 with most patients being seen seven to eight times. Before therapy 80.6% were

graded as poor and 19.4% were graded fair on the basis of specific criteria. The orthoptic therapy resulted in the attainment of excellent binocular status in 64.5% of the patients. The long-term follow-up revealed 51.7% classified as excellent and 32.3% improved from the initial examination.

Wick B. Accomodative esotropia: Efficacy of therapy. J Amer Optom Assoc, 58(7): 562-566, 1987.

Retrospective examination was performed on the records of 54 patients who had undergone vision therapy for treatment of accommodative esotropia. The patients were classified on the Duane classification as having either convergence excess (n=11) or equal esodeviations (n=43). Over 90% of the patients achieved total restoration of normal binocular function with treatment. The results and implications of this study are discussed.

Wick B, Cook D. Management of anamalous correspondence: Efficacy of therapy. Am J Optom & Physiol Optics, 64(6): 405-410, 1987.

This study evaluated recently reported success rates for treatment and presented an estimate of the prognosis for successful binocular re-education of patients with esotropia and anomalous correspondence. Based on current therapy techniques reported in the literature, with careful aggressive therapy, 50% of esotropic patients with anomalous correspondence should be expected to achieve binocular vision provided sufficient time (up to 12 months) can be devoted to binocular re-education

Ziegler D, Huff D, Rouse MW. Success in strabismus therapy: A literature review. J Amer Optom Assoc, 53(12): 979-9883, 1982.

The purpose of this study was to review the literature pertaining to non-surgical cure rates for strabismus published since 1958 and compare it to Flom's prognostic model. From the studies which specified Flom's functional cure or its equivalent, it was determined that strabismic cure rates using vision therapy could be broken down as follows:

Constant esotropia – 29%	Intermittent esotropia – 73%
Constant exotropia - 53%	Intermittent exotropia - 62%