

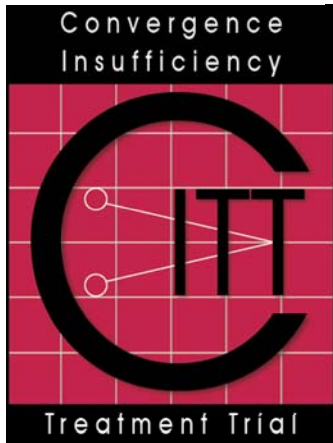
# Convergence Insufficiency An Update

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Fellow, American Academy of Optometry



# A Randomized Clinical Trial of Treatments for Symptomatic Convergence Insufficiency in Children

Thanks to:

Mitchell Scheiman, OD, FCOVD

CITT Study Chair

Pennsylvania College of Optometry at Salus University

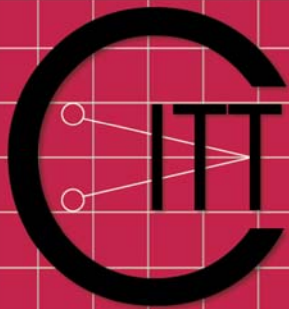
For the CITT Investigator Group

Supported by the National Eye Institute of the National Institutes of Health,  
Department of Health and Human Services: **U10 EY014713-01A2**



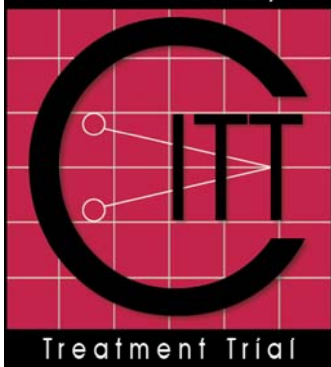
# Large Scale CITT

- NEI funded CITT large-scale randomized clinical trial October 2004
  - 9 clinical sites (Collaborative)
    - 6 optometry, 3 ophthalmology
  - Completed 12-week primary outcome examinations February 2007
  - Completed 12-month, long-term follow-up examinations February 2008



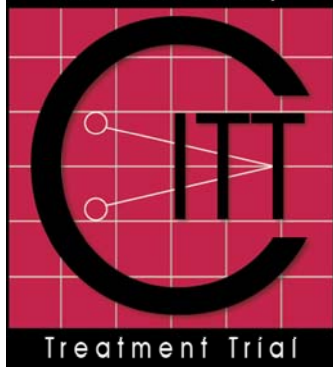
# Purpose

- To determine the effectiveness of commonly used active treatments for improving CI-related symptoms and signs in children with symptomatic convergence insufficiency (CI)



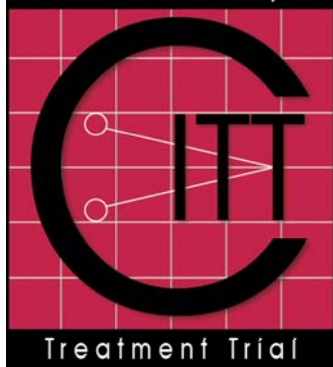
# Symptoms Survey

		Never	(Not Very Often) Infrequently	Sometimes	Fairly Often	Always
1.	Do your eyes feel tired when reading or doing close work?					
2.	Do your eyes feel uncomfortable when reading or doing close work?					
3.	Do you have headaches when reading or doing close work?					
4.	Do you feel sleepy when reading or doing close work?					
5.	Do you lose concentration when reading or doing close work?					
6.	Do you have trouble remembering what you have read?					
7.	Do you have double vision when reading or doing close work?					
8.	Do you see the words move, jump, swim or appear to float on the page when reading or doing close work?					
9.	Do you feel like you read slowly?					
10.	Do your eyes ever hurt when reading or doing close work?					
11.	Do your eyes ever feel sore when reading or doing close work?					
12.	Do you feel a "pulling" feeling around your eyes when reading or doing close work?					
13.	Do you notice the words blurring or coming in and out of focus when reading or doing close work?					
14.	Do you lose your place while reading or doing close work?					
15.	Do you have to re-read the same line of words when reading?					



# Study Design

- Multi-center, placebo-controlled, randomized, clinical trial
- Subjects aged 9 to <18 years



# Study Design

- Well defined criteria for CI
  - Exodeviation at near at least  $4\Delta$  greater than at far
  - Receded near point of convergence (NPC) break (6 cm or greater)
  - Insufficient positive fusional vergence (PFV) (i.e., failing Sheard's criterion or minimum of  $\leq 15\Delta$  BO blur or break)



# Study Design

- Randomly Assigned to 4 treatment groups
  - Home-based Pencil Push-up Therapy (HBPP)
  - Home-based Computer Vergence/Accommodative Therapy and Pencil Push-ups (HBCVAT+)
  - Office-based Vergence/Accommodative Therapy with Home Reinforcement (OBVAT)
  - Office-based Placebo Therapy (OBPT)

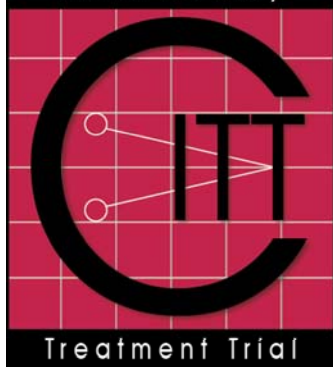




# Study Design

## Why 12 weeks?

- 12 weeks of treatment
  - Home-based groups
    - Initial session with therapist
      - Patient learned home procedures & demonstrated ability to perform them
    - Written instructions for home therapy procedures
    - Weekly phone appointments with therapist
    - Monthly office visits with therapist



# Study Design

- Office-based groups
  - Weekly, 60 minute, in-office treatment sessions
  - Home therapy procedures to reinforce in-office therapy
    - Written instructions for home therapy procedures



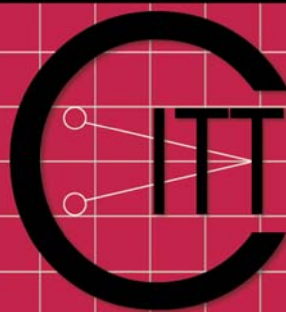
# Study Design

- Masked Examinations
  - After 4 and 8 weeks of treatment
  - After 12 weeks of treatment
    - Primary outcome examination
  - At 6 and 12 months after treatment completion
    - Long term follow-up examinations



# Outcome Measures

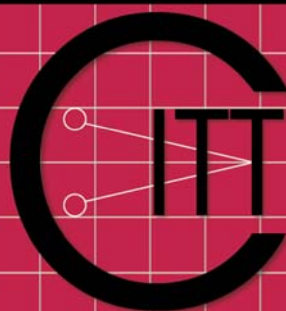
- Primary outcome measure
  - Symptom score on CI Symptom Survey (CISS)
- Secondary outcome measures
  - NPC break
  - PFV at near



# Outcome Measures

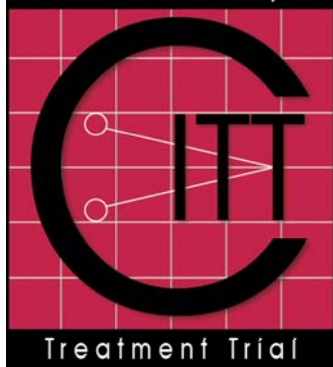
**Table 4. Comparing Treatment Groups With Respect to Clinical Measures at Baseline and the 12-Week Outcome Examination\***

<b>Characteristic</b>	<b>Pencil Push-Ups (n = 11)</b>	<b>Vision Therapy/Orthoptics (n = 15)</b>	<b>Placebo Vision Therapy/Orthoptics (n = 12)</b>
CI Symptom Survey score at baseline	29.3 (5.4)	32.1 (7.9)	30.7 (10.6)
CI Symptom Survey score at outcome	25.9 (7.3)	9.5 (8.2)	24.2 (11.9)
NPC break at baseline, cm	14.6 (7.4)	13.7 (7.4)	15.5 (6.8)
NPC break at outcome, cm	9.1 (5.1)	4.5 (3.6)	9.3 (4.4)
PFV break at baseline, Δ	12.6 (3.2)	12.5 (4.3)	12.1 (3.4)
PFV break at outcome, Δ	14.5 (5.3)	31.8 (10.0)	19.8 (10.3)



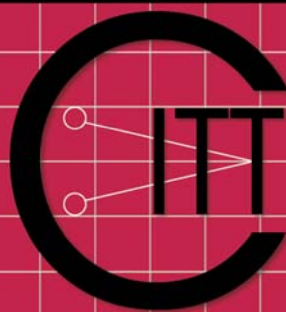
# Summary

- **Office-Based VT** was significantly more effective than Home-Based Pencil Pushups, Home-Based Computer VT, and Office-Based Placebo Therapy in improving both the symptoms and clinical signs associated with symptomatic CI in children



# Summary

- Although symptoms improved somewhat in the two home-based therapies, these treatments were no more effective in improving symptoms than Office-Based Placebo Therapy!

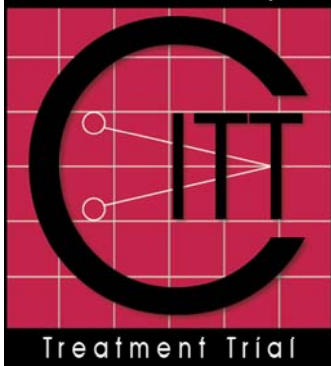


# VT Description

**Table 2. Office-Based Vision Therapy/Orthoptics Procedures**

<b>Accommodative Procedures</b>		
<b>Vision Therapy/Orthoptics Procedure</b>	<b>Description of Procedure</b>	<b>Purpose of Procedure</b>
Loose-lens accommodative facility	The patient must alternately clear 20/30- to 20/50-size print at 40 cm though plus and minus lenses	Improve amplitude of accommodation; increase velocity of accommodative response; decrease the latency of the accommodative response
Letter chart accommodative facility	The patient must alternately clear 20/30-size print at 40 cm and then at 6 m	
Binocular accommodative facility	Same procedure as loose-lens accommodative facility performed binocularly	
<b>Convergence Procedures</b>		
Barrel card	Patient must accurately converge on targets on a handheld card 5 cm from the eyes	Develop the kinesthetic awareness of converging and diverging; develop the ability to voluntarily converge; normalize the near point of convergence
Brock string	Patient must accurately converge on target placed on a string; the target distance can be varied from several meters to 5 cm	
<b>Fusional Vergence Procedures</b>		
Vectograms	Patient must maintain single binocular vision as targets are disparated to create base-out or base-in vergence demand	Increase positive and negative fusional vergence amplitudes
Computer orthoptics (random dot stereogram procedure)	Patient must maintain single binocular vision as random dot stereograms are disparated to create base-out or base-in vergence demand	
Aperture rule	Patient must converge or diverge to achieve single binocular vision with targets with increasingly larger base-out or base-in vergence demand	
Eccentric circles free-space fusion cards	Patient must converge or diverge to achieve single binocular vision with targets with increasingly large base-out or base-in vergence demand	
Life Saver free-space fusion cards	Patient must converge or diverge to achieve single binocular vision with targets with increasingly larger base-out or base-in vergence demand	
Loose prism facility	Patient must converge or diverge to achieve single binocular vision with through prisms of varying magnitude	





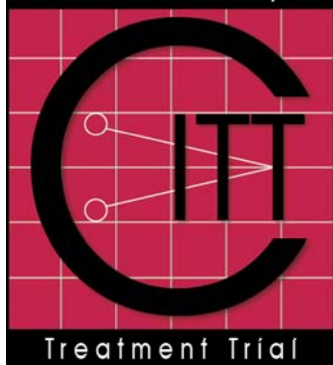
# Translating Results to Clinical Practice

- Results can only be applied to children 9 to <18 years old with symptomatic CI
- Findings indicate that this specific form of vision therapy (OBVT) is most effective of the treatments studied in this trial
- About 75% of patients achieved normalization of or improvement in symptoms and signs within a 12-week period



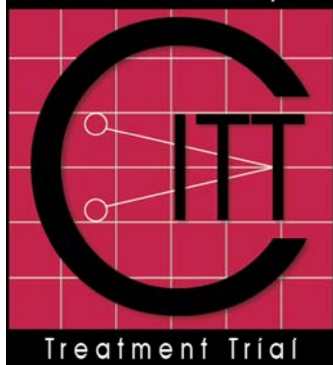
# New Questions

- CITT not designed to show the maximal improvement possible
  - A longer duration of treatment may have resulted in additional changes in signs and symptoms.
  - OBVT programs for CI are often 12 to 24 office visits.
  - It is possible that OBVT might have been effective in more patients had the treatment program been of longer duration.



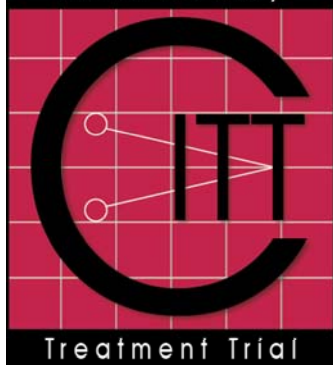
# New Questions

- Likewise, a longer treatment program may have resulted in additional improvements by those assigned to the home-based treatment groups.
- It is also possible that using more home-based therapy procedures, or prescribing longer periods of daily home-based therapy may have produced different results.



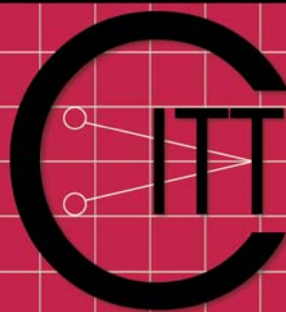
# New Questions

- Was improvement in the home-based groups due to placebo effect?
  - No home-based placebo group in the CITT
- For the OBVT regimen, we do not know which procedures were most effective or why, and whether the treatment protocol can be modified to make it more effective



# Conclusion

- This large-scale multi-center, randomized clinical trial demonstrates that a 12-week regimen of OBVT was significantly more effective than a 12-week program of HBPP or HBCVT in improving symptoms and signs associated with symptomatic CI in children
- OBVT should be considered the first-line treatment approach for the treatment of symptomatic CI in children 9 to 17 years old



CLINICAL TRIALS

SECTION EDITOR: ROY W. BECK, MD, PhD

## A Randomized Clinical Trial of Treatments for Convergence Insufficiency in Children

Mitchell Scheiman, OD; G. Lynn Mitchell, MAS; Susan Cotter, OD; Jeffrey Cooper, OD, MS; Marjean Kulp, OD, MS; Michael Rouse, OD, MS; Eric Borsting, OD, MS; Richard London, MS, OD; Janice Wensveen, OD, PhD; for the Convergence Insufficiency Treatment Trial (CITT) Study Group

**Objective:** To compare vision therapy/orthoptics, pencil push-ups, and placebo vision therapy/orthoptics as treatments for symptomatic convergence insufficiency in children 9 to 18 years of age.

**Methods:** In a randomized, multicenter clinical trial, 47 children 9 to 18 years of age with symptomatic convergence insufficiency were randomly assigned to receive 12 weeks of office-based vision therapy/orthoptics, office-based placebo vision therapy/orthoptics, or home-based pencil push-ups therapy.

**Main Outcome Measures:** The primary outcome measure was the symptom score on the Convergence Insufficiency Symptom Survey. Secondary outcome measures were the near point of convergence and positive fusional vergence at near.

**Results:** Symptoms, which were similar in all groups at baseline, were significantly reduced in the vision therapy/orthoptics group (mean symptom score decreased from

32.1 to 9.5) but not in the pencil push-ups (mean symptom score decreased from 29.3 to 25.9) or placebo vision therapy/orthoptics groups (mean symptom score decreased from 30.7 to 24.2). Only patients in the vision therapy/orthoptics group demonstrated both statistically and clinically significant changes in the clinical measures of near point of convergence (from 13.7 cm to 4.5 cm;  $P < .001$ ) and positive fusional vergence at near (from 12.5 prism diopters to 31.8 prism diopters;  $P < .001$ ).

**Conclusions:** In this pilot study, vision therapy/orthoptics was more effective than pencil push-ups or placebo vision therapy/orthoptics in reducing symptoms and improving signs of convergence insufficiency in children 9 to 18 years of age. Neither pencil push-ups nor placebo vision therapy/orthoptics was effective in improving either symptoms or signs associated with convergence insufficiency.

*Arch Ophthalmol.* 2005;123:14-24

**Author Affiliations:** Eye Institute, Pennsylvania College of Optometry, Philadelphia (Dr Scheiman); Optometry Coordinating Center (Ms Mitchell), College of Optometry (Dr Kulp), The Ohio State University, Columbus; Southern California College of Optometry, Fullerton (Drs Cotter, Rouse, and Borsting); College of Optometry, State University of New York, New York (Dr Cooper); College of Optometry, Pacific University, Portland, Ore (Dr London); College of Optometry, University of Houston, Houston, Tex (Dr Wensveen).  
**Group Information:** A list of the members of the CITT Study Group appears on page 23.  
**Financial Disclosure:** None.

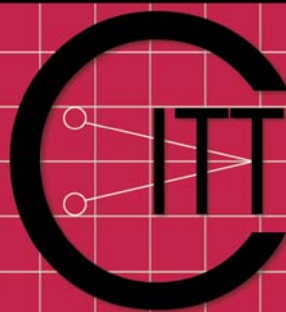
**C**ONVERGENCE INSUFFICIENCY (CI) is a common and distinct binocular vision disorder with a reported prevalence among children and adults in the United States of 2.25% to 8.30%.<sup>1-4</sup> Common symptoms include diplopia, asthenopia, headaches, and blurred vision usually associated with activities requiring close vision (eg, reading, computer viewing, or deskwork).<sup>5-12</sup> The exact impact of symptomatic CI on an individual's performance in school, at work, and on quality of life is unknown. Clinical signs of CI typically include exophoria that is greater at near than at distance, a receded near point of convergence measurement, and reduced positive fusional vergence at near measurement.<sup>5,13,14</sup>

There is a lack of consensus regarding the most appropriate treatment for CI. Various treatments are prescribed including base-in prism glasses, home-based pen-

cil push-ups, home-based vision therapy/orthoptics, and office-based vision therapy/orthoptics.<sup>15-24</sup> Recent studies surveying the ophthalmic community to determine the most widespread treatment modality for symptomatic CI suggest that pencil push-ups is the most commonly prescribed treatment by both ophthalmologists and optometrists.<sup>25,26</sup>

### For editorial comment see page 100

In spite of the popularity of pencil push-ups for CI, there has been only 1 clinical study of 25 patients evaluating the effectiveness of this treatment modality.<sup>24</sup> The patients with symptomatic CI who enrolled in the study were instructed to perform pencil push-ups at home for 15 minutes, 5 days a week; however, only 48% (12/25) completed the study, and of these, 58% (7/12) had improved symptoms and signs.



# AOA Preferred Practice Guideline

## QUICK REFERENCE GUIDE

# Care of the Patient with Accommodative and Vergence Dysfunction



American Optometric Association

### A. DESCRIPTION AND CLASSIFICATION

Accommodative and vergence dysfunctions are diverse visual anomalies. They occur when the visual system is incapable of performing near vision tasks efficiently either because these tasks lack the stereoscopic cues required for accurate vergence responses or because the tasks require accurate and sustained accommodative and vergence functioning without fatigue. Most symptomatic patients have defects in more than one area of binocular vision, e.g., a patient with an accommodative dysfunction may have a secondary vergence problem and a patient with a vergence dysfunction may have a secondary accommodative problem.

- Accommodative dysfunction** interferes with the ability of the eyes to focus clearly on objects at various distances, resulting in the lack of clear retinal images.
- Vergence dysfunction** involves disjunctive eye movements in which the visual axes move toward each other (convergence) or away from each other (divergence), resulting in the inability of the eyes to accurately fixate and stabilize a retinal image.

Classifications of accommodative and vergence dysfunction, described in Tables 1 and 2, respectively, include:

#### 1. Accommodative Dysfunctions

- Accommodative insufficiency
- Ill-sustained accommodation
- Accommodative infacility
- Paralysis of accommodation
- Spasm of accommodation

#### 2. Vergence Dysfunctions

- Convergence insufficiency
- Divergence excess
- Basic exophoria
- Convergence excess
- Divergence insufficiency
- Basic esophoria
- Fusional vergence dysfunction
- Vertical phoria

### B. RISK FACTORS

#### 1. Accommodative Dysfunction

- Need to sustain increased accommodation for viewing targets at near
- Accommodative fatigue
- Accommodative adaptation
- Slow accommodation
- Various drugs and certain systemic diseases (e.g., diabetes mellitus, myasthenia gravis)

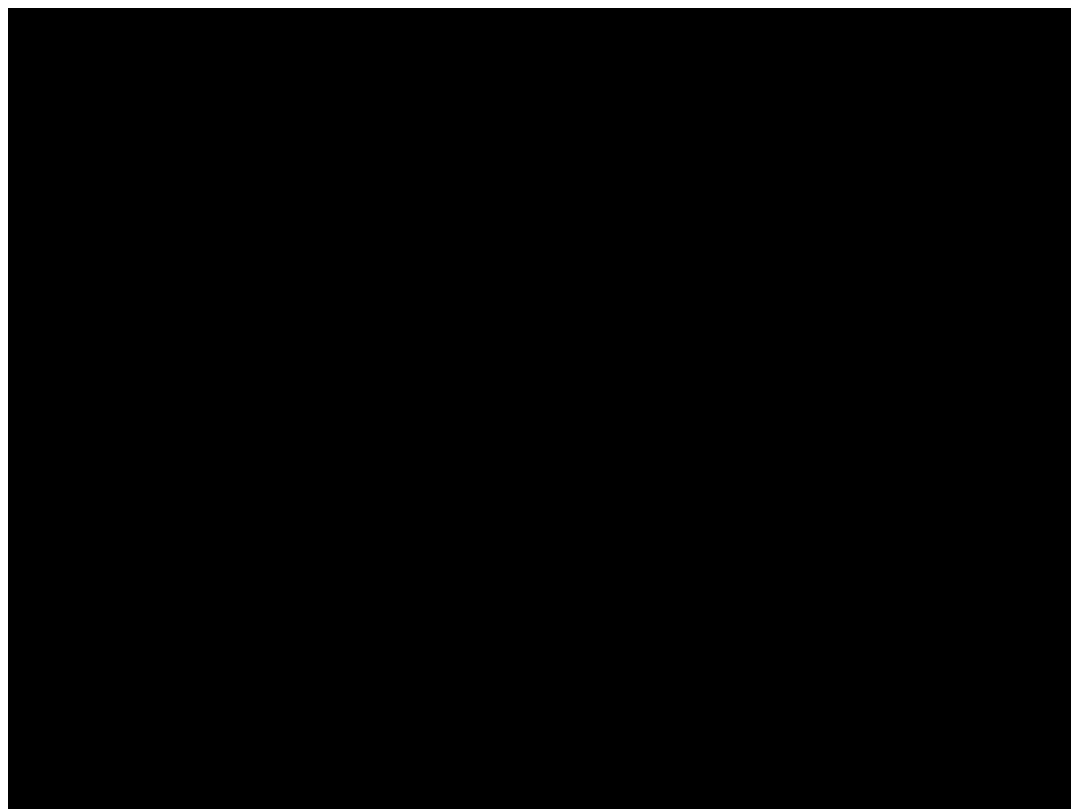
**NOTE:** This Quick Reference Guide should be used in conjunction with the [Optometric Clinical Practice Guideline on Care of the Patient with Accommodative and Vergence Dysfunction](#) (Reviewed 2001). It provides summary information and is not intended to stand alone in assisting the clinician in making patient care decisions.

*Published by:*

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# NIH Site Video







# VT1 Protocol

7/29/2009

OEPF Clinical Curriculum Level 1

## OEP The Optometric Extension Program Foundation

Clinical Curriculum Course Content

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### Level I Vision Therapy Curriculum for Visual Dysfunctions

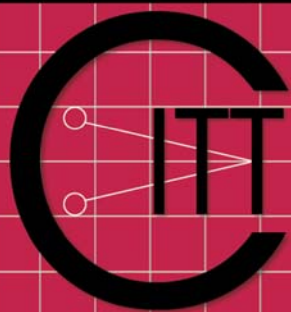
NOTE: Activities in green have a demonstration video that can be accessed from the specific page for that procedure.

1	<a href="#">Eye Control (Homework)</a>	<a href="#">Orientation Checklist Instructions</a>		<a href="#">Hart-Chart Near-Far Rock (Homework)</a>	<a href="#">Liteboard Near-Far</a>
2		<a href="#">Square Balance Board</a>	<a href="#">C-P Saccades (Homework)</a>		<a href="#">Laserspec</a>
3		<a href="#">Walking Rail</a>	<a href="#">Flashlight Pointing (Homework)</a>	<a href="#">Look Hard Look Soft (Homework)</a>	
4				<a href="#">Mental Mimic (Homework)</a>	<a href="#">Eyetone Biofeedback</a>
5	<a href="#">Coin Circles (Homework)</a>				
6			<a href="#">VisionBuilder Peripheral Vision</a>		<a href="#">Laserspec</a>
7		<a href="#">Motor Equivalent</a>	<a href="#">Wallach Rings</a>	<a href="#">Monocular Accommodative Rock (Homework)</a>	<a href="#">Eyetone Biofeedback</a>
8	<a href="#">Physiological Diplopia (Homework)</a>				<a href="#">Rotator Circles</a>
9		<a href="#">Squinchel</a>	<a href="#">Thumb Overlap (Homework)</a>		<a href="#">Liteboard Near C-P Way</a>
10	<a href="#">Brock String (Homework)</a>		<a href="#">Projected Stereo/BSM</a>		
11		<a href="#">Rotator T's</a>	<a href="#">Projected Vectograms</a>		<a href="#">See 3 Coins (Homework)</a>
12				<a href="#">Binocular Accommodative Rock (Homework)</a>	<a href="#">Overlapping Pictures (Homework)</a>
13	<a href="#">Bue on String (Homework)</a>	<a href="#">Visicare Int. Disassociated</a>	<a href="#">Keystone Fusion Games</a>		

[www.oepf.org/ClinicalC/level1.php](http://www.oepf.org/ClinicalC/level1.php)

1/2

Convergence  
Insufficiency



Treatment Trial

# Thank You

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