OPEN ACCESS

Greenfort International Journal of Applied Medical Science

Abbreviated Key Title: Grn Int J Apl Med Sci | ISSN 3048-6904(P) | ISSN 2584-2420(O) |
Greenfort International Publisher, Assam, India
Journal homepage: https://gipublisher.com/journals/gijams

Review Article DOI: 10.62046/gijams.2025.v03i04.003

Effectiveness of Vision Therapy in Managing Convergence Insufficiency and Accommodative Dysfunction: A Comprehensive Review

Preethi Anie E[1], Heber Anandan[2*], Dhanisha J L[3], Jenesha Blessie K[4]

[1]Assistant Professor, Dr. Agarwal's Institute of Optometry, Tirunelveli, Tamil Nadu, India
[2]Addl. DG of Research, Dr. Agarwal's Institute of Optometry, Tirunelveli, Tamil Nadu, India
[3]Associate Professor & Principal, Dr. Agarwal's Institute of Optometry, Tirunelveli, Tamil Nadu, India
[4]Lecturer, Dr. Agarwal's Institute of Optometry, Tirunelveli, Tamil Nadu, India

***Corresponding Author:** Heber Anandan | **Received:** 17.06.2025 | **Accepted:** 09.08.2025 | **Published:** 30.08.2025

Abstract: Convergence insufficiency (CI) and accommodative dysfunction are prevalent binocular vision disorders that can impact both children and adults, often resulting in significant discomfort during near vision tasks. This review aggregates findings from clinical trials, systematic reviews, and neuroimaging studies to assess the effectiveness of various vision therapy protocols in treating these conditions. Most of the evidence supports office-based vision therapy, typically combined with home exercises, as the most beneficial method for enhancing clinical outcomes and alleviating symptoms associated with CI. However, the role of home-based therapies and their effectiveness in addressing other binocular and accommodative disorders remains uncertain. The review concludes with recommendations for clinical applications and future research directions.

Keywords: Convergence insufficiency, vision therapy, accommodative dysfunction, orthoptics, paediatric optometry, non-strabismic binocular vision disorders.

Citation: Preethi Anie E *et al.* Effectiveness of Vision Therapy in Managing Convergence Insufficiency and Accommodative Dysfunction: A Comprehensive Review. Grn Int J Apl Med Sci, 2025 Jul-Aug 3(4): 217-220.

INTRODUCTION

Convergence Insufficiency (CI) is defined as a binocular vision disorder where individuals struggle to converge their eyes adequately for near tasks. This condition often manifests with symptoms such as eye strain, double vision, headaches, and difficulties with concentration [1,2]. Accommodative dysfunction, frequently co-occurring with CI, involves challenges in adjusting or maintaining focus [3]. Due to the high rates of these disorders in school-aged children and working adults, identifying effective treatment strategies is essential. This review analyzes findings from randomized clinical trials, systematic reviews, and observational studies conducted from 1986 to 2022. The studies were selected based on their relevance to vision therapy and orthoptic treatments for CI and accommodative dysfunction. The populations examined ranged from children to older adults, incorporating sample sizes from individual case studies to extensive randomized trials.

Vision Therapy for Convergence Insufficiency in Children:

Numerous studies have validated the effectiveness of vision therapy in paediatric populations. In an interventional study by ***Jang (2017)***, 32 elementary school children with symptomatic CI underwent eight weeks of structured vision therapy utilizing tools such as the Brock string and barrel cards. Significant improvements were observed in near point of convergence (NPC), positive fusional vergence (PFV), and accommodative response [1]. Similarly, ***Chin Nor Ah (2022)*** conducted a systematic review involving over 1,700 paediatric patients, finding that structured vision therapy programs, particularly those delivered in-office, resulted in meaningful improvements sustained over a 12-month follow-up period [2]. ***Scheiman and colleagues (2005, 2009, 2011, 2014)*** provided further evidence through a series of randomized controlled trials (RCTs) that demonstrated how office-based vergence/accommodative therapy, combined with home reinforcement, significantly outperformed placebo treatments and home-based pencil push-ups in children. Notable improvements were seen in subjective symptoms and objective clinical metrics, including NPC and PFV [3-7].

Vision Therapy in Adults with Convergence Insufficiency:

Research also indicates that vision therapy benefits adult populations, though fewer studies specifically concentrate on this group. ***Birnbaum et al. (1999)***

showed that a combination of office-based therapy and home exercises resulted in a remarkably higher success rate in adults compared to home therapy alone or no treatment [8]. ***Alvarez et al. (2010)*** contributed a neurophysiological dimension, revealing functional changes in brain activity observed through fMRI following therapy, suggesting that central neural adaptations accompany clinical improvements [9]. ***Aletaha (2018)*** compared three therapy modalities in adults and found that enhanced office-based therapy, using optical aids, achieved the most substantial improvements in clinical parameters and symptom scores [10].

Accommodative Dysfunction and Vision Therapy:
Vision therapy also appears effective in addressing accommodative disorders, which often co-occur with CI. Studies conducted by ***Scheiman (2011) and Rouse (1998)*** revealed substantial gains in accommodative amplitude and facility following structured therapy, particularly in office settings. Importantly, these improvements persisted during follow-ups extending up to a year after treatment [3,11]. ***Ciuffreda (2002)*** reinforced these findings with a theoretical approach based on motor learning, confirming that vision therapy produces measurable physiological changes in both accommodative and vergence systems [12].

Comparative Efficacy of Vision Therapy Modalities:
Several investigations have explored the relative effectiveness of various vision therapy approaches. ***Martinez (2009)*** reviewed the literature, highlighting the superiority of in-office therapy over home-based or placebo methods for addressing CI. They also emphasized the need for further research to discover effective strategies for binocular and accommodative conditions that are not related to ***CI*** [14]. ***Lavrich (2010) and McGregor (2014)*** agreed that orthoptic therapy remains the most effective treatment option for CI, advising caution regarding the use of prisms and other non-standard treatments [15,16].

Durability and Long-Term Outcomes:
Longitudinal studies such as that by ***Grisham (1988)*** reported a 72% cure rate, with improvements persisting for at least two years. This supports the hypothesis that vision therapy can induce long-term neuroplastic changes, especially when reinforced with home-based maintenance exercises [13].

Table-1: Management of Convergence Insufficiency (CI) and Accommodative Insufficiency (AI) [5,6]

Office-Based Vision Therapy (OBVT):
• Supervised therapy with evidence-based procedures (e.g., Brock string, vectograms, jump convergence).
• Typically conducted weekly for 12–16 sessions.
Home-Based Therapy:
• Pencil push-ups, Brock string, computer-based vergence exercises.
• Less effective unless supported by office sessions and close monitoring.
Prism Lenses:
• Temporary symptomatic relief in patients who cannot undergo VT.
Plus lenses for near if accommodative insufficiency co-exists.

Table-2: Management of Accommodative Insufficiency (AI)

Monocular Accommodative Therapy (MAT): Begin with monocular tasks to stimulate accommodation without binocular demands.
• **Monocular lens sorting** (using lenses from +2.00 to –6.00D).
• **Hart Chart used for near and far distance reading.**
• **Monocular Accommodative Rock**: o ±2.00D flippers and gradually increase speed and accuracy.
Binocular Accommodative Rockutilizing flippers while preserving single, clear, and stable binocular vision.
• **Brock String :** Integrate convergence along with accommodation
• **Lens Tromboning**: Moving a lens in and out while maintaining clear vision on a near target.
Integrative Techniques
• **Computerized VT programs**: Software like HTS or VTS4 that provide adaptive accommodative tasks.
• **Reading tasks with plus/minus lenses**: To simulate classroom demands and improve endurance.
• **Jumps between different distances** (far-near-far reading): To enhance real-world accommodative flexibility.

DISCUSSION

This review synthesizes evidence from clinical trials, systematic reviews, and neurophysiological studies to evaluate the effectiveness of vision therapy in managing convergence insufficiency (CI) and accommodative dysfunction. Collectively, the findings underscore the

efficacy of structured office-based vision therapy, particularly when combined with home reinforcement exercisesas the most reliable intervention for improving both subjective symptoms and objective clinical signs in individuals affected by these binocular vision disorders.

Multiple studies, including the pivotal randomized controlled trials (RCTs) by **Scheiman *et al.*** [3–7], and the interventional study by **Jang (2017)** [1], frequently indicate significant enhancements in clinical metrics like NPC, PFV and accommodative response in paediatricgroups participating in office-based vision therapy.The large-scale systematic review by **Chin Nor Ah (2022)** [2], encompassing data from over 1,700 children, further reinforces the superiority of structured, in-office interventions over less formal home-based alternatives. These outcomes demonstrate the therapy's sustained benefits, even at 12-month follow-up intervals, highlighting its long-term value in clinical management.

While research in adult populations is more limited, available studies suggest similar therapeutic benefits**. Birnbaum *et al.* (1999)** [8] found that adults with CI achieved significantly greater improvements when treated with a combination of office-based therapy and home exercises, compared to home-based therapy alone or placebo. Neurophysiological evidence from **Alvarez *et al.* (2010) [9]**, using functional MRI, reveals that vision therapy not only improves clinical symptoms but also results in increased neural activation in brain regions associated with vergence control, supporting the theory that vision therapy leverages neuroplastic mechanisms for recovery. These findings are complemented by **Ciuffreda's (2002)** theoretical model [**12]**, which posits that motor learning principles and cortical adaptation underlie improvements in both vergence and accommodation systems. Accommodative dysfunction often coexists with CI, and evidence suggests that vision therapy effectively addresses both conditions. Studies by **Rouse *et al.* (1987)** [11] **and Scheiman (2011)** [3] report notable gains in accommodative amplitude and facility following structured therapy programs, which were maintained during long-term follow-up. These results support the integration of accommodative training into CI treatment protocols, especially in paediatric populations.

Comparative studies, such as those by **Martinez (2009)** [14], **Lavrich (2010)** [15], **and McGregor (2014)** [16], reinforce the conclusion that office-based vision therapy, including orthoptic techniques, remains the most effective intervention for CI. Home-based exercises like pencil push-ups, although commonly prescribed, consistently underperform when compared to supervised in-office therapy. **Aletaha (2018)** [10] adds that augmented office therapy, particularly when optical aids or computerized tools are included, leads to even more pronounced improvements. Despite these encouraging findings, there is limited consensus regarding the best approach to treating accommodative or binocular vision anomalies not directly associated with CI.

Limitations and Research Gaps:

Despite robust findings, several limitations are apparent in the existing literature. Sample sizes vary widely, with certain studies having limited generalizability due to small cohorts. There is also a lack of standardized protocols across studies, making direct comparisons challenging. Furthermore, long-term follow-up beyond one year is relatively scarce, and few studies have rigorously evaluated the cost-effectiveness or accessibility of office-based vision therapy, particularly in underserved populations.

Future Directions:

- Develop standardized and scalable therapy protocols for clinical applications.
- Investigate neurobiological markers of treatment responsiveness using neuroimaging techniques.
- Conduct research to include adult populations and non-CI binocular/accommodative disorders to enhance clinical applicability.

CONCLUSION

This comprehensive review demonstrates that vision therapy is a highly effective intervention for managing convergence insufficiency and accommodative dysfunction, particularly in children. The evidence consistently supports the superiority of office-based vision therapy combined with home exercises over other treatment modalities, including home-based therapies and placebo. Significant improvements in clinical measures such as near point of convergence, positive fusional vergence, and accommodative response highlight the potential of structured therapy in alleviating symptoms and enhancing visual function. For adults with convergence insufficiency, while the body of research is less extensive, available studies indicate that office-based therapy can achieve substantial results when combined with home reinforcement. Furthermore, the neurophysiological changes observed following therapy suggest that vision therapy may foster central adaptations that contribute to clinical improvement. Despite these encouraging findings, ambiguities persist regarding the effectiveness of home-based therapies and the optimal treatment strategies for other binocular and accommodative disorders. Therefore, ongoing research is necessary to explore these areas and refine best practices in vision therapy.

REFERENCE

1. Jang JU, Jang JY, Tai-Hyung K, Moon HW. Effectiveness of vision therapy in school children with symptomatic convergence insufficiency.

Journal of ophthalmic & vision research. 2017 Apr;12(2):187.
2. Ah CN. Efficiency of vision therapy for convergence insufficiency in children. Efficiency of vision therapy for convergence insufficiency in children. 2022 Jun 1;102(1):18-.
3. Scheiman M, Cotter S, Kulp MT, Mitchell GL, Cooper J, Gallaway M, Hopkins KB, Bartuccio M, Chung I, Convergence Insufficiency Treatment Trial Study Group. Treatment of accommodative dysfunction in children: results from a randomized clinical trial. Optometry and Vision Science. 2011 Nov 1;88(11):1343-52.
4. Scheiman M, Mitchell GL, Cotter SA, Kulp M, Chase C, Borsting E, Arnold E, Denton C, Hertle R, CITT-ART Investigator Group. Convergence insufficiency treatment trial–attention and reading trial (CITT-ART): Design and methods. Vision development and rehabilitation. 2015 Oct;1(3):214.
5. Scheiman M, Cotter S, Kulp M, Mitchell GL, Jones-Jordan L, Gallaway M, Borsting E, Hertle R, Chase C, Schulman E, Tamkins S. Treatment of Symptomatic Convergence Insufficiency in Children enrolled in the CITT-ART Randomized Clinical Trial. Optometry and vision science: official publication of the American Academy of Optometry. 2019 Nov;96(11):825.
6. Scheiman M. Treatment of symptomatic convergence insufficiency in children with a home-based computer orthoptic exercise program. Journal of the American Association for Pediatric Ophthalmology and Strabismus (JAAPOS). 2011 Apr 1;15(2):123-4.
7. Scheiman MM. 2017 Glenn A. Fry Award Lecture: Establishing an Evidence-based Literature for Vision Therapy—A 25-year Journey. Optometry and Vision Science. 2018 Aug 1;95(8):632-42.
8. Birnbaum MH, Soden R, Cohen AH. Efficacy of vision therapy for convergence insufficiency in an adult male population. J Am Optom Assoc. 1999;70:225 232.
9. Alvarez TL, Scheiman M, Santos EM, Morales C, Yaramothu C, d'Antonio-Bertagnolli JV, Gohel S, Biswal BB, Li X. Clinical and functional imaging changes induced from vision therapy in patients with convergence insufficiency. In2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) 2019 Jul 23 (pp. 104-109). IEEE.
10. Aletaha M, Daneshvar F, Mosallaei M, Bagheri A, Khalili MR. Comparison of three vision therapy approaches for convergence insufficiency. Journal of ophthalmic & vision research. 2018 Jul;13(3):307.
11. Rouse MW, Hyman L, Hussein M, Solan H. Frequency of convergence insufficiency in optometry clinic settings. Optometry and Vision Science. 1998 Feb 1;75(2):88-96.
12. Ciuffreda KJ, Hung GK. Model-based understanding of clinical vergence testing. In Models of the Visual System 2002 (pp. 625-641). Boston, MA: Springer US.
13. GrishamJD.Visualtherapyresultsforconvergenceinsufficiency:aliterature review. AmJOptom Physiol Opt. 1988;65:448-454.
14. Martínez PC, Muñoz ÁG, Ruiz-Cantero MT. Treatment of accommodative and nonstrabismic binocular dysfunctions: a systematic review. Optometry-Journal of the American Optometric Association. 2009 Dec 1;80(12):702-16.
15. Lavrich JB, Hamburger JL, Lee KE, Thuma TB, Omega ML, Zhang QE, Gunton KB. Creating consistency in the diagnosis of convergence insufficiency: Screening methods. Journal of American Association for Pediatric Ophthalmology and Strabismus. 2023 Dec 1;27(6):346-e1.
16. McGregor ML. Convergence insufficiency and vision therapy. Pediatric Clinics of North America. 2014 Jun 1;61(3):621-30.

Acronyms:
CI - Convergence Insufficiency
AD - Accommodative Dysfunction
AI - Accommodative Insufficiency
NPC - Near Point of Convergence
PFV - Positive Fusional Vergence
AR - Accommodative Response
RCT - Randomized Controlled Trials
fMRI - Functional Magnetic Resonance Imaging
AA - Accommodative Amplitude
OBVT - Office-Based Vision Therapy
HBVT - Home-Based Vision Therapy
MAT - Monocular Accommodative Therapy
HTS - Home Vision Therapy Software
VTS4 - Vision Therapy Software