# Effectiveness of Orthoptic Exercises for Symptomatic Convergence Insufficiency in Post-Stroke Patients: A Single Case Study

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### Abstract

Convergence insufficiency (CI) is a common binocular vision disorder that affects near vision and can significantly impact the quality of life, particularly in individuals recovering from a stroke. CI is characterized by symptoms such as diplopia, eye strain, headaches, and difficulty with reading, which can hinder rehabilitation. This case study evaluates the effectiveness of a structured orthoptic exercise program in alleviating symptomatic CI in a post-stroke patient. A 51-year-old male with a history of ischemic stroke and complaints of near vision diplopia was recruited. He underwent a structured orthoptic therapy program, including pencil push-ups and stereogram exercises, for 15-minute sessions, three days a week, over a period of three weeks. Pre- and post-intervention assessments were conducted using the Convergence Insufficiency Symptom Survey (CISS). The results revealed a significant improvement in CISS scores, with the Neat point convergence have reduced from  $\geq 15$  cm to  $\leq 8$  cm and Convergence Insufficiency Symptom Survey (CISS)Score from  $\geq 30$  to  $\leq 15$ , therefore there was a marked reduction in symptoms of diplopia, eye strain, and difficulty in reading. The patient also reported subjective improvements in near vision tasks, indicating enhanced functional vision. These findings suggest that orthoptic exercises can serve as a non-invasive and cost-effective intervention for post-stroke CI rehabilitation. Given the positive outcomes observed in this case study, structured orthoptic therapy may be considered a viable approach for managing post-stroke CI. However, further research with larger sample sizes and long-term follow-ups is warranted to validate these findings and develop standardized rehabilitation protocols.

**Keywords:** Convergence Insufficiency, Diplopia, Orthoptic Exercises, Post-Stroke Rehabilitation, Visual Therapy.

## Introduction

Convergence Insufficiency (CI) is a binocular vision disorder characterized by the inability to maintain proper eye alignment during near tasks leading to symptoms such as eye strain, double vision, headaches, and difficulty focusing on close objects [1]. Stroke a leading cause of long-term disability often results in various neuro-ophthalmic complications including CI. Damage to cortical and subcortical pathways responsible for binocular vision coordination may contribute to the development of CI in post-stroke patients [2]. This condition can significantly hinder functional recovery, affecting daily activities and vocational reintegration. The prevalence of CI in the general population ranges from 2% to 13% with a higher occurrence among individuals with neurological impairments including stroke survivors [3]. Stroke-related neurological deficits can disrupt the brain's ability to regulate eye movements potentially worsening or triggering CI symptoms. Despite being well-documented in idiopathic cases the exercises effectiveness of orthoptic in

managing stroke-induced CI remains underexplored [4].

Orthoptic exercises are non-invasive visual therapies aimed at improving binocular coordination by enhancing convergence and accommodation. These exercises including smooth convergence exercises (such as pencil push-ups), jump vergence exercises (like the Brock string and near-point dot cards) and exercises, commonly stereogram are recommended for CI treatment. However, stroke survivors may present additional challenges, such as cognitive, motor, and sensory impairments which can influence treatment adherence and outcomes [5, 6, 7]. In clinical practice, symptomatic Convergence insufficiency (CI) is typically managed through a variety of interventions, with orthoptic exercises. The specific visual training exercises designed to improve eye coordination and convergence being one of the most recommended treatments. While the effectiveness of orthoptic exercises in improving convergence ability and alleviating associated symptoms in general populations has been studied, there is limited research on their application and outcomes in post-stroke patients. Stroke survivors may present unique challenges, such as cognitive, motor, and sensory impairments, which can influence the success and adherence to treatment protocols.

This study aims to evaluate the effectiveness of a structured orthoptic exercise regimen, specifically stereogram exercises and pen convergence exercises in improving convergence function and alleviating symptoms in a post-stroke patient with CI over a three-week period. By assessing the feasibility and benefits of visual rehabilitation in stroke survivors this research contributes to a better understanding of the intersection between neurological impairments and visual dysfunction. The findings may help refine rehabilitation strategies and integrating visual therapy as a key component in post-stroke

recovery programs to enhance the quality of life for stroke survivors with CI [8, 9].

## **Case Description**

Patient history: A 51-year-old male presented with complaints of double vision, eye strain, and difficulty maintaining focus on near tasks, particularly experiencing discomfort while reading for more than 10 minutes. His symptoms were accompanied by a three-day history of headaches following an ischemic stroke. Upon evaluation, he was diagnosed with convergence insufficiency (CI) a binocular vision disorder commonly observed in poststroke patients significantly affecting his ability to perform daily activities requiring sustained near vision.

To address his visual disturbances, a structured orthoptic exercise program was implemented aimed at improving convergence ability and alleviating symptoms of diplopia. The prescribed intervention included two targeted visual training exercises: stereogram exercises and pen convergence exercises. Stereogram exercises help train the brain to fuse images from both eyes effectively, improving depth perception and convergence control. Pen convergence exercises commonly known as pencil push-ups, strengthen the extraocular muscles responsible for near vision focus and coordination.

The treatment plan was carefully structured to ensure gradual visual rehabilitation while minimizing fatigue. The patient underwent supervised orthoptic exercises in 15-minute sessions, three times per week, over a threeweek period. This systematic approach aimed to enhance his convergence function by progressively challenging his binocular vision skills. The effectiveness of the intervention was assessed through clinical evaluations and symptom tracking before and after therapy. The structured rehabilitation program was designed to improve treatment adherence, promote visual recovery, and enhance the patient's overall quality of life following his ischemic stroke. **Clinical Findings:** A detailed ophthalmic and neurological evaluation revealed the following findings:

- 1. Visual Acuity: Normal for both distance and near vision.
- 2. Ocular Motility: Full range of motion observed in both eyes.
- 3. Near Point of Convergence (NPC): Markedly receded, indicating convergence insufficiency.
- 4. Cover Test: Exophoria at near fixation, suggesting difficulty in maintaining binocular fusion.
- 5. Convergence Insufficiency Symptom Survey (CISS) Score: Elevated, confirming significant symptom burden.
- 6. Stereopsis: Reduced, indicating impaired depth perception and binocular function.
- 7. Accommodation: Mildly reduced, contributing to near vision difficulties.
- 8. Neurological Examination: No significant motor deficits but reported visual discomfort affecting daily activities.

These findings confirmed the diagnosis of symptomatic convergence insufficiency secondary to ischemic stroke.

#### Rehabilitation

The intervention included stereogram exercises and pen convergence exercises, performed in 15-minute sessions, three times a week for three weeks.

Stereogram Exercise Protocol:

- 1. Initial Positioning: The patient held the stereogram card at arm's length and placed a pen centrally between the images on the card.
- 2. Focus on the Pen: The patient was instructed to look at the pen while slowly bringing it toward the nose, remaining aware of the images on the card without directly looking at them.
- 3. Image Fusion: As the pen moved closer, the images on the card began to double (e.g.,

two cats appearing as four). At an optimal convergence point, the two central images fused into one.

- 4. Maintaining Focus: The patient was guided to resist the urge to look directly at the card and instead maintain focus on the pen while stabilizing the fused image.
- 5. Progression: Once the central image was achieved, the patient worked on making it clearer. Gradually, the pen was removed while maintaining focus at the convergence point.
- 6. Advanced Step: The patient practiced voluntary convergence by imagining a point halfway between the card and their eyes, achieving a third image without the pen.

Pen Convergence Exercise Protocol:

- 1. Holding a Pen: The patient held a pen at arm's length, focusing on its tip.
- 2. Bringing the Pen Closer: The pen was slowly moved toward the nose while maintaining focus, stopping when double vision occurred.
- 3. Sustaining Convergence: The patient attempted to keep the image single for as long as possible before taking a short break and repeating the exercise.
- 4. Increasing Difficulty: Over time, the patient aimed to bring the pen closer before experiencing diplopia, progressively improving convergence ability.

These exercises were performed under supervision ensuring proper technique and gradual adaptation. The intervention aimed to improve convergence function reduces symptoms of diplopia and enhance near vision performance in post-stroke convergence insufficiency.

Post-intervention results showed significant improvement in convergence ability reduction in symptoms and enhanced functional vision, indicating the effectiveness of the orthoptic exercise program shown in Table.1.

Assessment Parameter	Pre-Intervention Score	Post-Intervention Score (After 3 weeks)
Near Point of Convergence (NPC)	Receded (≥15 cm)	Improved (≤8 cm)
Convergence Insufficiency Symptom Survey (CISS) Score	High (≥30)	Reduced (≤15)
Stereopsis	Reduced	Improved
Diplopia Severity	Moderate to Severe	Mild to None
Reading Duration	<10 minutes	>20 minutes

Table 1. Pre-Intervention and Post-Intervention Outcome Scores

#### **Results**

The Case study reveals that Near Point Convergence of post - intervention score have reduced from  $\geq 15$  cm to  $\leq 8$  cm and Convergence Insufficiency Symptom Survey (CISS)Score from  $\geq 30$  to  $\leq 15$ . Also Stereopsis, Diplopia and duration of reading are enhanced to normal with the rehabilitation intervention of pencil push-ups and stereogram exercises, for 15-minute sessions, three days a week, over a period of three weeks.

#### Discussion

Effective management of diplopia requires precise diagnosis and a tailored treatment approach, emphasizing the need for thorough evaluation and interdisciplinary collaboration. Research supports the effectiveness of orthoptic exercises improving convergence in insufficiency (CI) and reducing associated symptoms [10, 11]. The study highlighted orthoptic exercises as a non-invasive and effective intervention for alleviating asthenopic symptoms in CI patients benefiting both children and adults. Additionally studies suggest that treating CI in children with ADHD may positively impact visual symptoms and attention, though further research is needed to explore this connection [12, 13]. Visual impairments including CI are prevalent among affecting stroke survivors, functional independence and quality of life. A study emphasized the importance of early visual screening in stroke rehabilitation, advocating for its integration into routine care to enhance recovery outcomes [14, 15]. Moreover a research found orthoptic exercises is beneficial in managing convergence and fusion deficiencies reinforcing the need for a structured rehabilitation approach [16]. Studies on traumatic brain injuries (TBI) demonstrate that eye movement training significantly improves gaze accuracy and reduces diplopia symptoms. These findings suggest that incorporating eye movement exercises into rehabilitation programs can enhance visual function and overall recovery [17, 18]. The management of diplopia requires accurate diagnosis and a personalized treatment plan due to the condition's complexity. Research highlights the effectiveness of eye movement training in reducing diplopia symptoms and improving gaze accuracy in patients with traumatic brain injury (TBI). The study emphasizes а comprehensive, bilateral approach in rehabilitation strategies for oculomotor disorders. It concludes that incorporating eye movement exercises in future interventions can optimize recovery outcomes for patients suffering from diplopia. A holistic, bilateral approach to oculomotor rehabilitation is crucial in optimizing patient outcomes. Future research should focus on refining visual therapy techniques to further improve recovery in patients with stroke-related and TBI-induced visual impairments [19, 20-23].

## Conclusion

single-case study highlights This the effectiveness of orthoptic exercises in improving convergence function and reducing symptoms of convergence insufficiency (CI) in a post-stroke patient. After a three-week structured intervention, the patient demonstrated significant improvements in near point of convergence, reduced diplopia symptoms, and increased reading endurance. These results suggest that non-invasive orthoptic therapy can serve as a valuable rehabilitation strategy for stroke survivors experiencing visual impairments. While the findings are promising, further research with larger sample sizes is needed to confirm the broader applicability of these interventions. Early screening and integration of visual therapy into post-stroke rehabilitation programs may enhance functional recovery and overall quality of life for affected individuals.

### Recommendations

- 1. Integration into Stroke Rehabilitation Orthoptic exercises should be incorporated into standard post-stroke rehabilitation programs to address convergence insufficiency and improve visual function.
- Early Screening & Assessment Routine vision screening, including the Near Point of Convergence (NPC) test and Convergence Insufficiency Symptom Survey (CISS), should be conducted for stroke patients to facilitate early detection and intervention.

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- Personalized Treatment Plans Tailoring orthoptic exercise programs to individual patient needs, considering cognitive and motor impairments, can enhance treatment adherence and effectiveness.
- 4. Home-Based Exercise Programs Encouraging stroke survivors to continue pencil push-ups, stereogram exercises, and pen convergence exercises at home can reinforce treatment benefits and support long-term improvement.
- 5. Interdisciplinary Collaboration Coordination between ophthalmologists, neurologists, physiotherapists, and rehabilitation specialists is essential for comprehensive patient care.
- Further Research Larger clinical studies are needed to establish standardized protocols, assess long-term outcomes, and explore additional visual therapy techniques for post-stroke convergence insufficiency.

## **Conflict of Interest**

The authors declare that there is no conflict of interest.

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