Review Article

Vision Therapy for Presbyopia: A Systematic Review

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Abstract

Purpose: To systematically review the available evidence on the role of vision therapy in presbyopia management.
Materials and Methods: A systematic search was conducted in PubMed, Google Scholar, Cochrane Library, and Wiley for studies published between 1990 and 2024. Eligible studies assessed the effects of vision therapy, accommodative training, orthoptic exercises, or perceptual learning on presbyopic patients. Data on visual acuity, accommodative amplitude and facility, pupil size, patient satisfaction with near vision, and outcomes of eye exercises were extracted.
Results: From 87,404 initial records, 325 articles were screened, and 7 studies met inclusion criteria. These studies demonstrated that vision therapy may improve accommodative amplitude, near visual acuity, accommodative facility, and patient satisfaction. However, the evidence is limited by small sample sizes, heterogeneous methodologies, and short follow-up periods, which restrict generalizability.
Conclusion: Vision therapy shows potential as a non-invasive adjunct for presbyopia management, but current evidence is insufficient for definitive recommendations. Well-designed randomized controlled trials with standardized protocols are needed to establish its clinical efficacy and long-term outcomes.

Keywords: Presbyopia; Vision Therapy; Accommodation; Vergence; Perceptual Learning; Non-Surgical Management.

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Introduction

Presbyopia is a physiological, age-related accommodative insufficiency that results in a gradual reduction of accommodative amplitude and near vision [1-5]. Symptoms usually appear progressively and may mimic those of accommodative disorders [3, 6-8]. The average age of onset is typically between 38 and 45 years, worsening until about 65 years of age [9-13]. It affects approximately 1.8 billion people worldwide, and its prevalence is expected to increase with global population aging [3,14].

Presbyopia, by reducing near visual acuity and increasing dependence on spectacles, has a substantial negative impact on quality of life [6, 14–17]. Despite the availability of several corrective strategies, access to them is suboptimal even in developed countries, and the global unmet need for presbyopia correction has been estimated at around 45% [4,5, 6, 14-22]. Uncorrected presbyopia is the most common cause of near visual impairment worldwide [6, 23].

The goal of presbyopia treatment is to compensate for accommodative dysfunction. Treatment choice depends on factors such as the severity of presbyopia, individual visual needs and preferences, cost and availability of options, and potential risks and benefits [4, 24-26]. Recent advances have expanded management strategies [24-27]. Current corrective or therapeutic options include spectacles, contact lenses, intraocular lenses, surgical approaches, and pharmacological treatments. Strategies such as monovision, simultaneous vision, extended depth of focus, and attempts to restore active ocular accommodation through invasive techniques are also employed [28- 30]. The efficacy of certain pharmacological agents in improving presbyopia symptoms has been demonstrated [31-33], though side effects, dose dependence, and temporary action must be considered.

In recent years, non-invasive methods such as vision therapy (orthoptic training) have attracted attention. Vision exercises have been proposed as an alternative approach to improve accommodative function and have proven effective in reducing symptoms of accommodative dysfunctions, particularly those associated with near work [34-50]. Barriers to spectacle use among presbyopic individuals include cost, limited access, lack of awareness, and misconceptions [51]. Compared with younger individuals, presbyopic patients treated with reading glasses report greater reductions in quality-of-life parameters [11]. The effectiveness of vision training in improving visual performance in presbyopia has been demonstrated [52]. Nevertheless, despite numerous studies on presbyopia correction, scientific evidence regarding the effectiveness of vision therapy remains limited and sometimes contradictory [53, 54]. Vision exercises play an important role in reducing asthenopic symptoms and may help alleviate presbyopia [38, 53, 55, 56].

For accommodative rehabilitation in presbyopic eyes, it is essential that the ciliary muscle remains capable of contracting with accommodative effort. With training, the ciliary muscle can regain its contractile strength [28]. Sustained contraction of the ciliary muscle in presbyopic eyes offers hope for restoring accommodation [28, 57]. Even with an additional pseudo-accommodation of 1-2 diopters, most of the visual demands of daily near tasks in presbyopic individuals can be met [57]. Repeated use of accommodation may also promote better accommodative performance [58, 59]. While vision therapy has been shown to improve accommodative ability in children and younger individuals

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and to reduce near-work-related symptoms its effect on accommodative systems in older individuals may differ [38], [49], [60], [61]. This scientific uncertainty highlights the need for further investigation to determine whether vision therapy can be an effective option for presbyopia management.

The purpose of this article is to review the available scientific evidence on vision therapy in presbyopia to determine whether this approach can serve as an effective treatment option or complement to conventional methods. Analysis of existing studies may provide clearer insight into the efficacy of these non-invasive interventions and guide future research.

Materials and Methods

This study was conducted as a systematic review to evaluate the effects of vision therapy on presbyopia. An electronic search was performed in PubMed, Google Scholar, Cochrane Library, and Wiley, in English, during 2024, covering the period from 1990 to 2024. The following keyword combinations were used: (presbyopia AND vision therapy), (presbyopia AND exercise), (presbyopia AND orthoptic), (presbyopia AND accommodation), and (presbyopia AND treatment).

Studies were included if they investigated the effect of vision therapy on presbyopia, were published between 1990 and 2024, contained relevant clinical or laboratory data, and included a control group or comparison with other treatment methods. Studies were excluded if they focused on optical, surgical, or pharmacological approaches, did not provide quantitative data, lacked standardized assessment methods, or evaluated vision therapy in non-presbyopic populations.

From a total of 87,404 initial records, after removal of duplicates and irrelevant articles, 325 studies were identified as related, and 7 were ultimately selected for detailed review. These studies were analyzed according to methodology, type of intervention, sample size, and reported outcomes. Extracted data included visual acuity, accommodative amplitude, accommodative facility, pupil size, patient satisfaction with near vision, and the impact of eye exercises. Findings were synthesized by comparing results across studies, identifying study limitations, and providing a critical analysis of the evidence. The process of study identification, screening, eligibility assessment, and inclusion is illustrated in the PRISMA flowchart (Figure 1)

Results

Perceptual learning, first introduced by Eleanor Gibson in 1963, involves repeated training with visual stimuli such as Vernier acuity, Gabor detection, position discrimination, letter recognition in noise, and contrast detection [62],[63]. Perceptual learning has been shown to improve visual acuity [64]- [66], with reduced lateral inhibition in the brain proposed as the neural basis [67]. Its use has also been explored in presbyopia. In a study by Thomson et al., [68] the effects of combining perceptual learning with non-invasive brain stimulation were evaluated. Thirty participants completed two weeks of contrast detection training combined with transcranial magnetic stimulation (TMS), transcranial random noise stimulation (tRNS), or sham transcranial direct current stimulation (tDCS). Both the tRNS and TMS groups demonstrated near vision improvements exceeding 1 LogMAR line, while the sham group improved less than 1 line. Improvements remained stable at 1-month follow-up. The authors concluded

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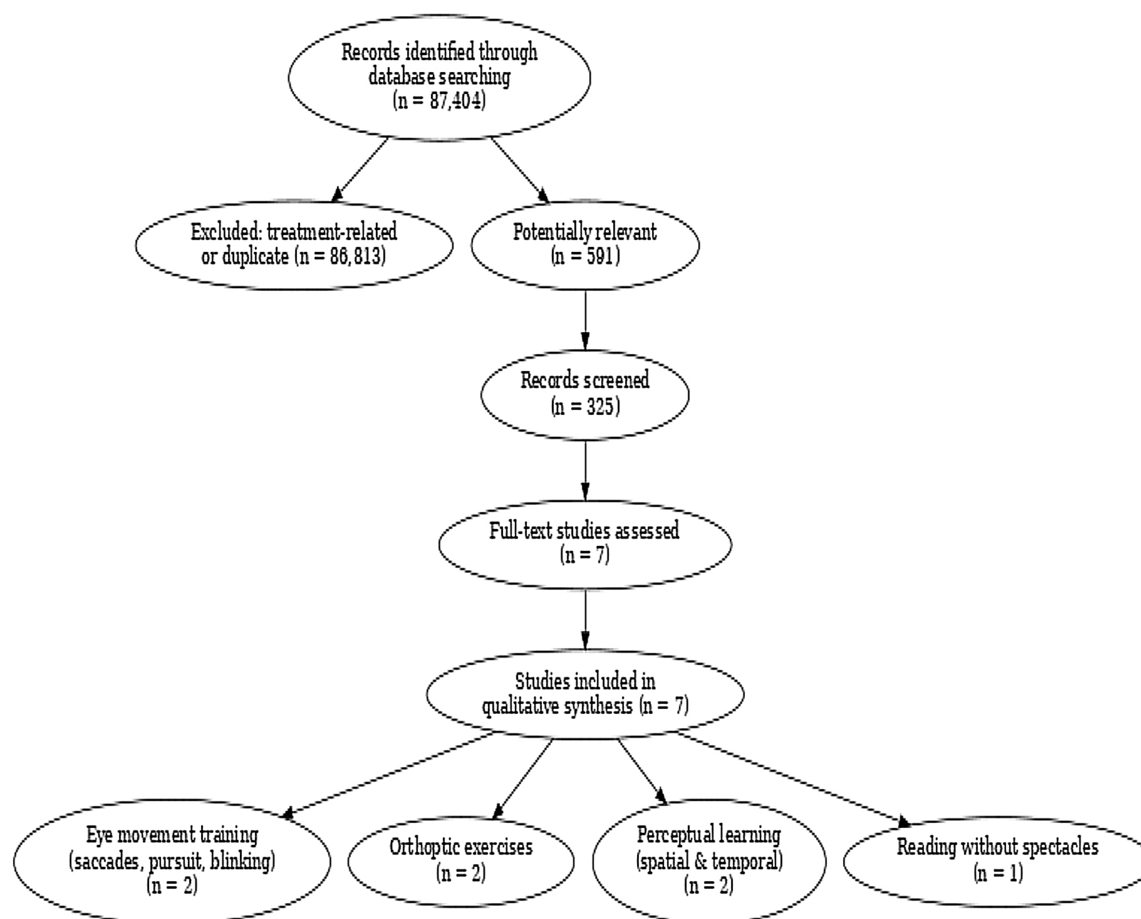

Figure 1: PRISMA flow diagram of study selection process

that combining non-invasive brain stimulation with perceptual learning holds promise for enhancing unaided near vision in presbyopia.

NeuroVision technology, a non-invasive perceptual learning program based on computer-based visual stimulation and cortical facilitation, was also investigated [69]. Durrie et al., [69] evaluated computer-based visual cortex training in 17 low myopes and 21 early presbyopes. Eleven myopic and 18 presbyopic patients underwent NeuroVision therapy, while nine served as controls. The treated myopes improved by a mean of 2.2 LogMAR lines in uncorrected visual acuity, and treated presbyopes improved similarly in uncorrected near vision. Contrast sensitivity also improved at all spatial frequencies in both treatment groups, while the control group showed no changes. Refractive error remained unchanged. The study concluded that NeuroVision effectively improved uncorrected distance and near vision as well as contrast sensitivity in early presbyopia [69].

Accommodative training methods include gradual tasks (e.g., push-ups) and rapid tasks (e.g., lens rock) [70]. One common technique is Hart chart accommodative rock, designed to restore normal amplitude and facility [70-71]. Lisa et al.,[52] introduced a resolution discrimination task in which participants judged sinusoidal versus square-wave gratings. Training included a fixed-distance group, an alternating-distance group, and a control group. Both training groups showed significant pre- to post-

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test improvements on the Landolt C chart, while only the fixed-distance group showed significant improvement on ETDRS. No significant changes were observed on contrast sensitivity testing compared with controls [52].

In another study, Sonioshi et al., [72] evaluated accommodative exercises in 23 presbyopes who repeatedly shifted gaze between near (30–40 cm) and far (>5 m) targets 20 times per set, four times daily for two months. Near visual acuity and accommodation did not improve, but pupil size decreased significantly and convergence increased. Overall satisfaction with near vision improved significantly [72].

Ocular exercises have been suggested to relax and reactivate eye muscles, stimulate aqueous circulation, improve ocular alignment, and enhance accommodative capacity [73-76]. Regular eye exercises may also improve visual perceptual sensitivity, flicker discrimination, and reduce eye fatigue [77]. Heganaur et al., [54] studied 34 presbyopic participants, divided into two groups: one received only ophthalmic care, while the other received care plus two months of eye exercises. The exercise group showed statistically significant improvements in visual acuity and overall near vision satisfaction, though refractive error did not change [54].

Virtual reality (VR) technology has also been tested. VR provides immersive three-dimensional interaction via head-mounted displays [54]. Previous reports suggested VR can train the ciliary muscle, relieve spasm, and enhance visual performance [79-81]. Guo et al., [34] evaluated VR training in 60 individuals with asthenopia, randomized into short-term (40 participants) and long-term (20 participants) groups. Short-term training improved visual acuity, accommodative amplitude, and facility, with reduced pupil size. Long-term training significantly improved accommodative amplitude and facility, but did not significantly change refractive error or visual fatigue.

Another approach was studied by Hopkins et al., [53] who developed a home-based “reading without spectacles” program involving six minutes of daily training in presbyopes aged 50-65. Eight participants underwent two pre-treatment and two post-treatment assessments. No significant changes in unaided near visual acuity or pupil size were found. Accommodation showed a transient improvement at the third examination, which did not persist. Clinically, the effect was not significant, but 87.5% of participants reported subjective improvement in near vision [53].

A second study by Heganaur et al., [54] also confirmed that two months of ocular exercise training improved clinical symptoms of asthenopia, near work performance, and satisfaction with near vision in presbyopes, though refractive error remained unchanged. A summary of included studies is provided in table 1.

Discussion

The findings of this systematic review demonstrate that vision therapy interventions, including perceptual learning, accommodative training, ocular exercises, and newer technologies such as NeuroVision and virtual reality, can produce measurable improvements in near visual function in presbyopic individuals. Several studies reported significant gains in visual acuity, accommodative amplitude, contrast sensitivity, or patient-reported satisfaction [52], [53], [54], [68–72], [78]. The most consistent benefits were observed with perceptual learning and accommodative training, which enhanced visual acuity and accommodative function, albeit with variation between protocols. More technologically

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Table 1: Summary of studies on vision therapy in presbyopia

Author (Year)	Age (years)	Intervention	Parameters	Duration	Results
Heganaur et al., [54]	49.6 ± 4.3 / 47.8 ± 6.3	Two groups: ophthalmic treatment alone vs. ophthalmic treatment + eye exercises (ocular motility and fixation training)	Distance visual acuity, refractive error, questionnaire	2 months (5 sessions/ week)	Significant improvement in visual acuity and near vision satisfaction; no significant change in refractive error
Thomson et al. ,[68]	Mean 50.1 (40-55)	Perceptual learning (contrast detection) combined with TMS, tRNS, or sham tDCS	Binocular near vision, contrast sensitivity, functional reading ability	2 weeks intervention + 1-month follow-up	Near vision improved >1 logMAR line in TMS and tRNS groups; improvements maintained at 1 month
Sonioshi et al.,[72]	48.5 ± 5.0	Repeated viewing of near (30–40 cm) and far (>5 m) targets, 20 times/set, 4 times/day	Near visual acuity, accommodation, pupil size, convergence	2 months	No improvement in near acuity or accommodation; significant pupil constriction and increased convergence; overall satisfaction improved
Lisa et al., [52]	>45 (Training: 49–64 alternating, 47-65 fixed; Control: 49–65)	Resolution discrimination (sinusoidal vs. square-wave gratings) with alternating vs. fixed distance training	Near and distance acuity, contrast sensitivity	20 days	Both training groups improved on Landolt C; only fixed-distance group improved on ETDRS; no significant change in contrast sensitivity
Guo et al., [34]	18-60 (Short-term: 33.5 ± 13.4; Long-term: 30.4 ± 11.7)	VR-based visual training, short-term (15 min once) vs. long-term (15 min, 3–4 times/day for 1 month)	Visual acuity, spherical equivalent, accommodative amplitude and facility, pupil size, questionnaire	Short: single session; Long: 1 month	Short-term group improved in acuity, amplitude, and facility with reduced pupil size; long-term group showed significant improvement in amplitude and facility; no significant changes in refractive error or fatigue
Durrie et al.,[69]	Myopia: 19-39; Presbyopia: 40–50	NeuroVision perceptual learning (non-invasive computer-based training)	Uncorrected distance and near visual acuity (UCVA, UCNVA), contrast sensitivity, spherical equivalent	30 sessions (2–3/week)	Presbyopes improved mean 2.2 LogMAR lines in unaided near vision; contrast sensitivity improved at all spatial frequencies; no significant change in refractive error
Hopkins et al., [53]	50-65	Home-based “reading without spectacles” program, 6 min/day	Unaided near acuity, accommodative accuracy, pupil size	Daily, assessment at 4 visits	No significant change in near acuity or pupil size; transient improvement in accommodation at visit 3; 87.5% reported subjective near vision improvement

Abbreviations: UCVA = Uncorrected distance visual acuity; UCNVA = Uncorrected near visual acuity; TMS = Transcranial magnetic stimulation; tRNS = Transcranial random noise stimulation; tDCS = Transcranial direct current stimulation; VR = Virtual reality.

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advanced methods, including NeuroVision and VR, demonstrated positive outcomes but require specialized equipment that may limit accessibility. Simpler methods such as accommodative push-ups or Hart chart training were easier to implement and still produced clinically relevant improvements, though often without robust statistical validation.

Most of the included studies had small sample sizes, such as Thomson et al., [68] with 30 participants, Sonioshi et al., [72] with 23, Hopkins et al., [53] with 8, and Heganaur et al., [54] with 34, which reduces statistical power and limits the generalizability of findings. In contrast, Guo et al.,[34] included 60 participants, but differences in age range and intervention design complicate direct comparison. Another limitation is the short duration of interventions and follow-up periods in most studies, which prevents assessment of the long-term stability of visual improvements [69]. In addition, heterogeneity of protocols and outcome measures makes it difficult to compare results across studies, as different methods were used to evaluate visual acuity, accommodation, contrast sensitivity, and patient satisfaction. Some trials also lacked rigorous control groups or failed to report complete statistical data, restricting interpretation [52], [53]. Finally, access to advanced technologies such as NeuroVision and virtual reality is limited, which may hinder broader clinical application [34],[69].

Future research should prioritize large, randomized controlled trials with standardized protocols and uniform outcome measures to allow meaningful comparisons. Longer follow-up is needed to determine the durability of visual and accommodative gains. Comparative studies of simple accommodative or ocular exercises versus technology-based interventions would clarify whether advanced devices provide additional benefits. Furthermore, research in real-world clinical and community settings is essential to assess cost-effectiveness, accessibility, and patient-reported outcomes. These steps will help define the role of vision therapy as a practical, safe, and affordable adjunct in presbyopia management.

Conclusion

This systematic review shows that vision therapy, including perceptual learning, accommodative training, ocular exercises, and newer technologies such as NeuroVision and virtual reality, can improve near visual function in presbyopia. However, the evidence is limited by small sample sizes, short follow-up and heterogeneous methodologies. Larger, well-designed trials are needed to confirm efficacy, establish standardized protocols, and determine long-term outcomes.

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Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of the present manuscript.

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