

Vision Therapy and Virtual Reality Applications



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Keywords

- Virtual reality • Perceptual learning • Vision therapy • Hebbian neuroplasticity
- Vision rehabilitation • Binocular dysfunction • Amblyopia

Key points

- Vision therapy is an evidence-based treatment of strabismic and nonstrabismic binocular vision dysfunctions, amblyopia, accommodative, oculomotor, visual processing, and visual-motor integration dysfunction.
- Clinical research in neuroscience is advancing our understanding of brain plasticity at any age, along with new therapeutic applications of highly motivating, patient-engaging vision-therapy computer-based programs evolving to the next generation, including virtual reality (VR).
- In addition to proper application of prescription lenses, prisms, and filters, using advanced methods of office-based vision therapy, including VR programs, can have a positive effect on patient outcomes in their vision rehabilitation treatment plan.

INTRODUCTION

Vision therapy provides an important vision care treatment modality for those patients with binocular vision problems and other problem areas in vision development and rehabilitation. The American Optometric Association has recognized this importance and defined vision therapy as a sequence of

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neurosensory and neuromuscular activities individually prescribed and monitored by the doctor to develop, rehabilitate, and enhance visual skills and processing. Visual skills include sensory and motor development of binocular vision, amplitude, accuracy, and facility of accommodation and oculomotor control of fixation, pursuits, and saccadic eye movement. In addition to these attributes of eye coordination, visual skills include a wide array of visual information processing functions, including visual discrimination, visual memory and sequential memory, visual-spatial relationships, and visual figure-ground. Layered on top of these functions of the visual acquisition processes of the visual system is the effective integration of these visual abilities with other sensory components of the brain involving auditory, balance, general and fine eye-hand coordination, as well as language abilities [1].

The evolution of vision therapy for binocular dysfunction

Pioneered by ophthalmologist Javal, the history of vision therapy began in the latter half of the nineteenth century as a noninvasive approach to treating strabismus. Javal was one of the first to establish the practice of orthoptics (ortho: “straight,” optics: “eyes”) as a sequential and systematic approach to include refractive compensation, occlusion in strabismic amblyopia, eliminating suppression, and development of diplopia awareness and motor fusion ranges. Dr Claud Worth, a prominent British ophthalmologist, expanded Javal’s methods and invented the amblyoscope to assist in sensory fusion. In the early part of the twentieth century 2 British ophthalmologists, Browne and Stevenson, published on the importance of training visual perception. Then in 1912, ophthalmologist Dr David Wells authored a comprehensive text on stereoscopic eye exercises. Optometric pioneers in the mid-twentieth century, including Skeffington, Getman, Hendrickson, Kraskin, Flax, Brock, Ludlam, Getz, and many others, helped to expand the models in vision therapy. They proposed that for vision therapy to be effective, it must reflect an understanding of the visual process to be more than a mechanical neuromuscular ability. Vision therapy should also include spatial awareness, gross motor bilateral integration, central-peripheral vision integration, oculomotor control, the integration between binocular vision and accommodation, and the transfer and application of these global visual skills into free space with automaticity. Leaders and researchers in the optometric profession have expanded the model of evidence-based vision therapy into the twenty-first century. Vision therapy has evolved to include instrumentation and techniques that build the relaxation, integration, flexibility, range, and stamina of visual skills that are necessary to improve patients’ quality of life. This expansion has included computer-generated vision therapy activities [2].

The development of computer technology in visually based programs has continued to expand into several other areas of medicine, pain management, psychological counseling, and rehabilitation, including vision therapy using a new type of therapeutic visual experience now referred to as virtual reality (VR) [3–5]. Through VR the participant becomes part of a 3-dimensional

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