Significant visual improvement with vision rehabilitation delayed three decades from disease onset

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ABSTRACT

Purpose: This is a report of an adult patient showing improvement in visual function from rehabilitation for longstanding homonymous hemianopsia. We present his medical history and visual function testing pre- and post-therapy, demonstrating an improvement in both subjective and objective measures.

Observation: A 40-year-old male with history of a ruptured arteriovenous malformation at age 10 years, treated with embolization therapy, was referred to the neuro-ophthalmology clinic for evaluation of right homonymous hemianopsia noted on Humphrey visual field (HVF) testing. At the most recent neuro-ophthalmology exam, the HVF showed a right homonymous hemianopsia with a mean deviation of −11.92 decibels (dB) in the right eye (OD) and −17.97 dB in the left eye (OS). He was referred to visual rehabilitation and showed marked improvement in visual functioning after a standard course of therapy.

Conclusions and importance: The efficacy of visual therapy is demonstrated in the literature. Notably lacking from the literature is a consideration of whether vision rehabilitation is similarly effective in patients that present distantly from the original insult. This case presents the potential for efficacy of visual rehabilitation even decades after the original insult. 1-6

1. Introduction

Vision rehabilitation provided by occupational therapy (OT) encourages engagement in daily activities. The goal of vision rehabilitation is to improve independence, safety, efficiency, and overall quality of life for patients experiencing vision loss or changes in visual function. 1-5 Functionally, patients with homonymous hemianopsia have limited scanning efficiency, impaired reading speed, and difficulty navigating environments. Restricted visual fields also decrease visual motor reaction times, processing speed, and visual cognition. 5,4

Support for the efficacy of visual rehabilitation is widespread in the literature, however, the literature generally lacks a consideration for the efficacy of vision rehabilitation in patients that present distantly from the original insult. 1-6 Studies suggest that most of the spontaneous improvement in visual function after injury occurs within one to two months, leading the authors to hypothesize that further improvement after 6 months post-injury can be attributed to the course of therapy. 2 Furthermore, some therapy methods have been demonstrated to clear that critical threshold of improving functioning in the patient’s daily life, not simply in the computer program of field of view metric/apparatus. Deeper investigation with fMRI has shown that useful field of view (UFOV) training decreases activity in areas of the brain involved with processing visual information like the thalamus, temporoparietal junction (TPJ), and visual cortex (VC), indicating that this training has enhanced critical connections and thus decreased the cognitive effort needed. 6

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We report a case of a patient demonstrating functional improvement with vision rehabilitation 30 years after onset. To our knowledge, this is the longest duration case from onset of visual loss to initiation and completion of occupational therapy vision rehabilitation (OTVR) in the English language, ophthalmic literature. This case supports the importance and value of clinician referral to vision rehabilitation, regardless of the onset or duration of visual loss.

2. Case report

A 40-year-old male with history of a ruptured arteriovenous malformation at age 10 years, treated with embolization therapy, was referred to the neuro-ophthalmology clinic for evaluation of right homonymous hemianopsia noted on Humphrey visual field (HVF) testing. At the most recent neuro-ophthalmology exam, the HVF showed a right homonymous hemianopsia with a mean deviation of −11.92 decibels (dB) in the right eye (OD) and −17.97 dB in the left eye (OS). Snellen visual acuity testing was 20/20 in both eyes (OU). He correctly identified 14/14 Ishihara color plates OU. These findings are consistent with previous exams.

Throughout childhood, the patient struggled to achieve age-appropriate physical, emotional, and social milestones. The patient attempted returning to school following the AVM at age 10, however, he withdrew due to multiple functional deficits and transitioned to home school. The patient attended college, requiring several additional years to earn a degree. Currently, the patient is married and a stay at home father of four children. The patient identified multiple challenges with organization, difficulty understanding words read by his children and an inability to help his children with detailed homework. The patient’s most significant concern was ensuring his visual skills were adequate for safe driving.

Occupational therapy vision rehabilitation was initiated 30 years post injury. The following outcome measures are summarized in Table 1 at intake and discharge. At the time of evaluation, the patient verbalized moderate perceived impairment at 58% using the Patient Specific Functional Scale. This measurement identifies specific areas of perceived impairment, a significant factor to determine the patient’s perception of performance and limitations. The patient identified impairment in tasks related to reading (3/10), helping children with detailed homework (3/10), driving (6.5/10), and becoming comfortable with vision loss (4/10).

The PEPPER Visual Skills for Reading Test (VSRT) assessed the patient’s saccadic eye movements, reading accuracy and efficiency, and compensatory strategies. The patient achieved 100% reading accuracy; however, reading efficiency was limited to 146.7 contextual words per minute. He demonstrated a consistent saccadic eye movement using large print (3.2 M) with increased reading errors on the right side of words. The patient required the use of a finger to maintain line placement when reading words and letters with increased crowding. Functionally, decreased reading efficiency and limited tolerance to visual clutter impacted full engagement with required occupations, specifically helping his children with homework.

Useful Field of View (UFOV) testing revealed normal processing speed (14 ms). Impairment was noted with divided attention (184 ms). Significant impairment was noted for selective attention (500 ms). The UFOV scores are well correlated with safe driving. Initially, the patient scored in Category 4, suggesting moderate to high risk for accident. The UFOV score corresponded with the patient’s functional driving complaints, specifically, difficulty with traffic, change in traffic patterns, additional distractions in the car, and managing complex information simultaneously.

Dynavision testing revealed slow visual motor reactions, reduced scanning efficiency, and limited compensation of the right visual field. Initially, the patient achieved an average of 54.5 hits/minute and average reaction time of 1.13 seconds per light. Decreased scanning efficiency and slowed visual motor reactions limit patient’s ability to locate and react to potential hazards and obstacles, increasing risk for accidents.

The patient received extensive vision rehabilitation including visual search and scanning techniques to compensate for the lost visual field. This included activities that promote a visual search while reading (reading to the end of the line), when locating something on a table (locating items in the impaired visual field on a table), or when walking (finding objects in the environment). Once visual scanning and visual search skills improved, the rehabilitation focused on higher-level visual skills. These include visual memory, pattern recognition, visual perception, and visual cognition including visual reasoning. Activities that promote these skills vary greatly but may include reading tasks, puzzles, logic puzzles, word searches, and sudoku games. With all of these activities provided, we consistently encourage habit development with the visual search and scanning techniques. Ideally, the client should learn to compensate for the visual field loss automatically and without thinking about it. All tasks were graded up to increase the challenge, through additional visual and auditory distractions that require multi-tasking to improve the patient’s ability to manage complex tasks. The patient attended weekly rehabilitation sessions and was provided home programs to promote carryover of visual skills and compensatory strategies. After the visual rehabilitation, the patient demonstrated markedly increased self-reported confidence in the use of visual skills; he demonstrated improved engagement in play with his children, improved accuracy with checking his children’s homework, enhanced problem solving with complex homework situations, and improved subjective driving safety. In addition to these subjective measures, the patient demonstrated objective measured progress throughout vision rehabilitation as evidenced by baseline and discharge measures.

3. Discussion

This case demonstrates that significant improvement in subjective and objective visual function is possible following vision rehabilitation in patients with impairments that have been untreated for extended periods of time. Generally, clinical approaches include prisms that relocate the visual image onto functioning visual field, visual scanning training to improve saccade efficacy at bringing objects located in the blind field into the intact field, and Visual Restoration Therapy (VRT) intended to recruit neurons at the border of the scotoma and marginally enlarge the functional visual field. The measured improvements in this patient present several questions: How adaptable is the adult visual system? How much potential improvement is forfeited with delayed versus early onset of vision rehabilitation? How do patient specific factors, disease etiologies, and training methodologies increase or decrease chances of success? Further research is needed to determine if improvements in visual function occur with delayed vision rehabilitation. Comparative studies would quantify how acute versus delayed vision rehabilitation affects potential for recovery and likelihood of

| Table 1 | Pre- and post-therapy assessments of the subject, reflecting subjective improvement. |
|---|---|---|
| **Outcome Measures** | **Initial** | **Discharge** |
| PSFS | 58% | 12.5% |
| PEPPER VSRT | 100% accuracy | 100% accuracy |
| | 146.7 efficiency | 189.4 efficiency |
| UFOV | 14 ms | 14 ms |
| Processing speed | 184 ms | 14 ms |
| Divided attention | 500 ms | 108 ms |
| Selective attention | 4 (high risk) | 1 (very low risk) |
| Category | | |
| Dynavision | 54.5 hits/minute | 69 hits/minute |
| | 1.13 seconds/light | |
success among different disease etiologies.

4. Conclusion

This case presents a patient experiencing significant visual and functional deficits, limiting occupational engagement and overall quality of life. The objective and subjective measurements reveal compelling functional improvement with vision rehabilitation initiated decades after disease onset. We believe that clinicians should be aware of occupational therapy and visual rehabilitation options and should refer patients for rehabilitation regardless of duration of visual loss.

Patient consent

The patient consented in writing to the publication of the case.

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Research ethics

We further confirm that any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

IRB approval was obtained (required for studies and series of 3 or more cases).

Written consent to publish potentially identifying information, such as details or the case and photographs, was obtained from the patient(s) or their legal guardian(s).

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Authorship

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