Article • A New Clinical Perspective for Monitoring Visual Fields in a Stroke Patient: The Automated Functional Field Tester [FCFT]

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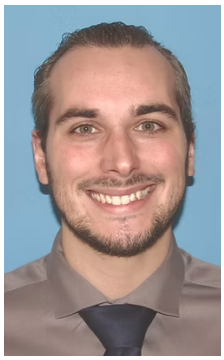

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ABSTRACT

Background: Stroke can affect the visual system in up to 65% of survivors, with 8-25% experiencing visual field deficits such as hemianopia or quadrantanopia. Although static perimetry is the standard method for assessing visual fields, it may not effectively capture the functional changes that occur during neuro-optometric rehabilitation. The Automated Functional Color Field Tester (FCFT) offers a kinetic alternative that may better reflect dynamic improvements in real-world vision.

Case Report: A 68-year-old male presented with persistent visual disturbances following a bilateral occipital ischemic stroke. Initial static perimetry revealed homonymous hemianopia, which later evolved into quadrantanopia. He was assessed using the FCFT and enrolled in a 14-week neuro-optometric rehabilitation (NOR) program incorporating in-office and home-based interventions. While static perimetry showed minimal changes over 13 months, the FCFT revealed measurable improvements across 7 of the 8 color isopters in terms of total area (cm^2) following the NOR program, correlating with improved spatial awareness and restored driving independence.

Conclusion: The FCFT provided objective, quantifiable measures of visual field recovery that static perimetry did not capture. It is a valuable addition for monitoring visual rehabilitation in stroke. This case represents the first documented use of FCFT in stroke, suggesting its value as a complementary tool to enhance clinical decision-making and guide patient care.

Keywords: automated functional field tester, hemianopia, quadrantanopia, stroke, vision rehabilitation, visual field

Introduction

Stroke affects more than 795,000 people in the United States annually, with 87% due to ischemic causes.[1] Up to 65% of survivors experience visual dysfunction, and 8–25% develop visual field loss such as hemianopia (54%) or quadrantanopia (15.2%).[2,3]

Clinicians commonly monitor these deficits using static perimetry protocols such as the Humphreys 24-2 or 30-2. Unlike traditional threshold-based methods, the Automated Functional Field Tester (FCFT) (Bernell Corporation, IN, USA) evaluates peripheral moving targets and total field area (cm^2), offering a dynamic and more practical perspective relevant to daily activities, such as grocery shopping.

The FCFT offers standardized kinetic color perimetry protocols across clinics, enhancing efficiency and consistency. It measures the central 30–40 degrees of the visual field using colored isopters (green, red, blue, and white) under controlled, repeatable conditions, requiring minimal examiner training. While manual methods remain the College of Syntonic Optometry's standard, interest in more reproducible techniques is increasing. Research is limited, but clinical adoption is expanding.

A multicenter pilot study reported normative trends in healthy adults.[4] The article discusses their protocol in detail; the current case is an example of its application. To date, the FCFT has been reported only in traumatic versus acquired brain injury.[5-7]

A couple of key advantages of this software, not often published, are the ability to track percentage changes and the total area (cm^2) in field size over time.[7] This report describes a novel approach to monitoring visual field changes after a neuro-optometric rehabilitation (NOR) program: its first documented use in a stroke patient, highlighting its role as a complement to static perimetry.

Case Report

WL, a 68-year-old male, presented in September 2023 following a bilateral ischemic occipital stroke sustained in February 2023. CT imaging confirmed the stroke, and an outside ophthalmologist reviewed it, but the author did not have access to the report. Initial field loss consisted of a homonymous hemianopia, which subsequently resolved into a quadrantanopia confirmed by Humphrey Visual Field (HVF) 24-2 testing (Figure 1).

The patient reported recurrent "whiteouts," impaired spatial awareness, poor depth judgment, slow gait with frequent collisions, and anxiety. He discontinued driving and relied on rideshare services. Past medical history included atrial fibrillation, hypertension, type 2 diabetes, and hypercholesterolemia.

Best-corrected visual acuity through manifest refraction was $20/20^{-1}$ in the right eye and $20/15^{-1}$ in the left eye. Pupils were equal and reactive with no afferent defect. Confrontation fields revealed superior-temporal constriction in the right eye and superior-nasal and temporal constriction in the left eye. Extraocular movements were full. Ocular health was unremarkable except for non-obstructive dermatochalasis.

Cover testing showed 4^{Δ} of exophoria at distance, 9^{Δ} at near, and 5^{Δ} of right hypophoria at both. A 3^{Δ} base-up prism over the right eye subjectively improved visual comfort and reduced "whiteouts," particularly during ambulation. In addition, yellow-tinted lenses alleviated symptoms of indoor photophobia.

Table 1. The Initial and Final Isopter Measurements, in Total Area (cm^2), for the Right and Left Eye for Each Color Isopter. (Green represents an expansion of total area from the initial visual field to the final visual field)

Color Isopters	Initial November 2023 (units cm^2)	Final July 2024
Right Eye:		
White (form)	55	113
Red	20	54
Green	17	31
Blue	86	83
Left Eye:		
White (form)	39	91
Red	36	51
Green	13	23
Blue	61	92

One month later, persistent symptoms despite prism and tint prompted further evaluation with the FCFT. The FCFT uses moving colored targets randomly presented from the periphery toward central fixation to evaluate peripheral field awareness and visual processing. The examiner clicks the mouse when the patient correctly identifies the target. Testing was performed using a 20 cm occlusion apparatus with +1.00 reading glasses for clarity (Figure 2), with fixation monitored from the side.

Initial FCFT results (Figure 3) mirrored HVF findings (Figure 1). As shown in Figures 3–5, the

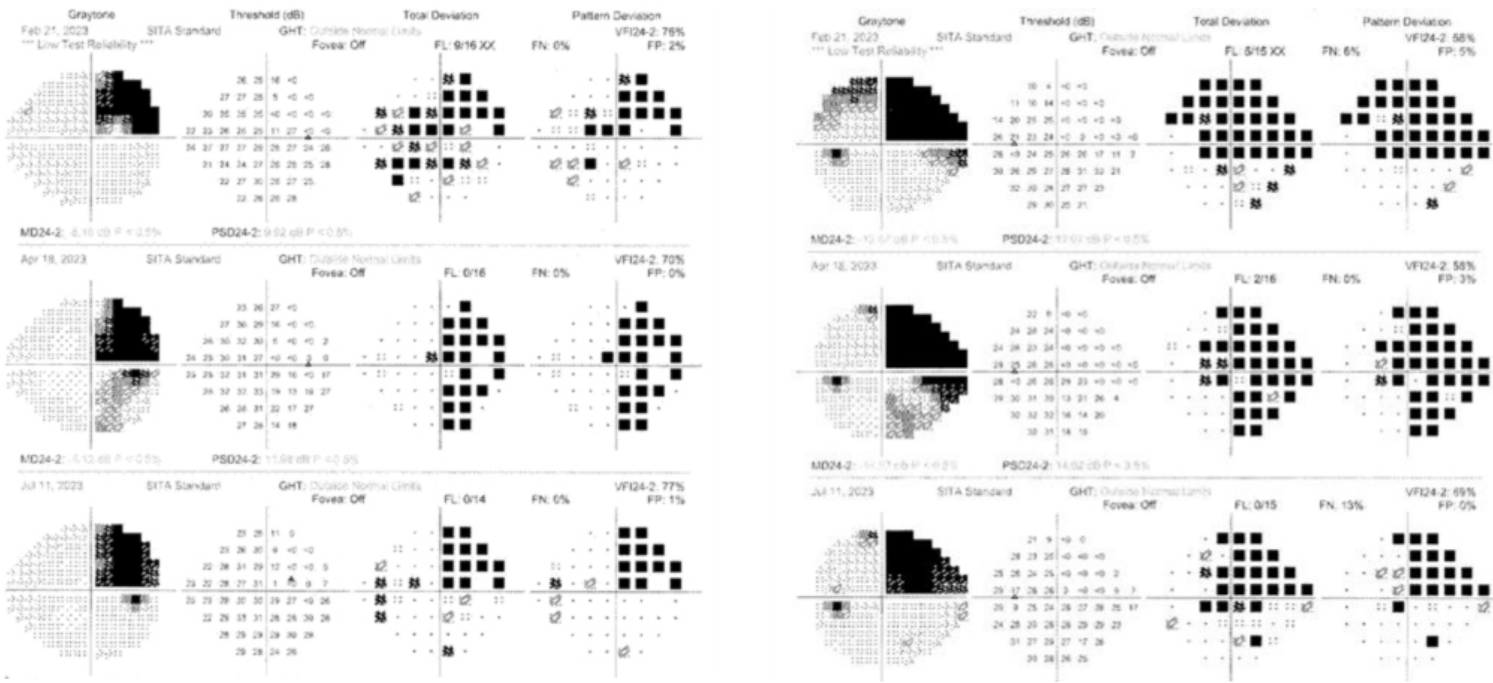

Figure 1. Humphrey visual field results of the right eye and left eye demonstrating the progression of post-stroke visual field changes. The patient initially presented with a quadrantanopia, which progressed to a hemianopia before partially recovering to a quadrantanopia. Test reliability initially showed low levels but demonstrated progressive improvement from Test 1 through Test 3.

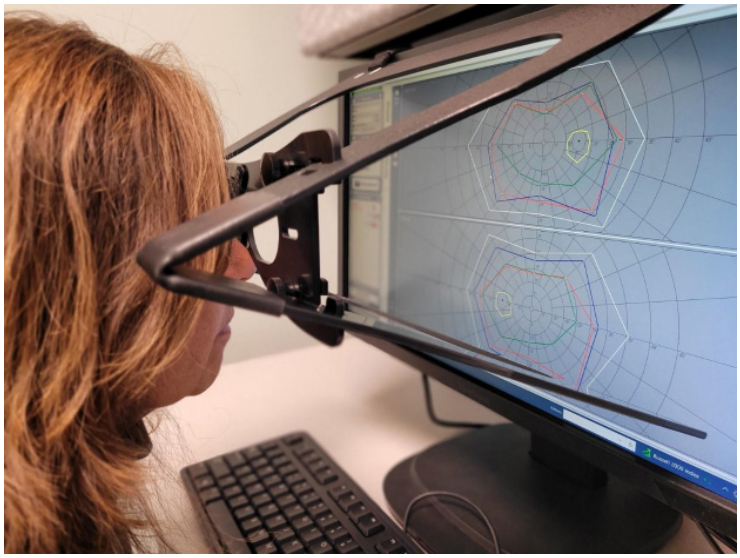

Figure 2. Example of the FCFT setup using an occlusion apparatus and trial lens holder. Examiner monitors fixation throughout testing.

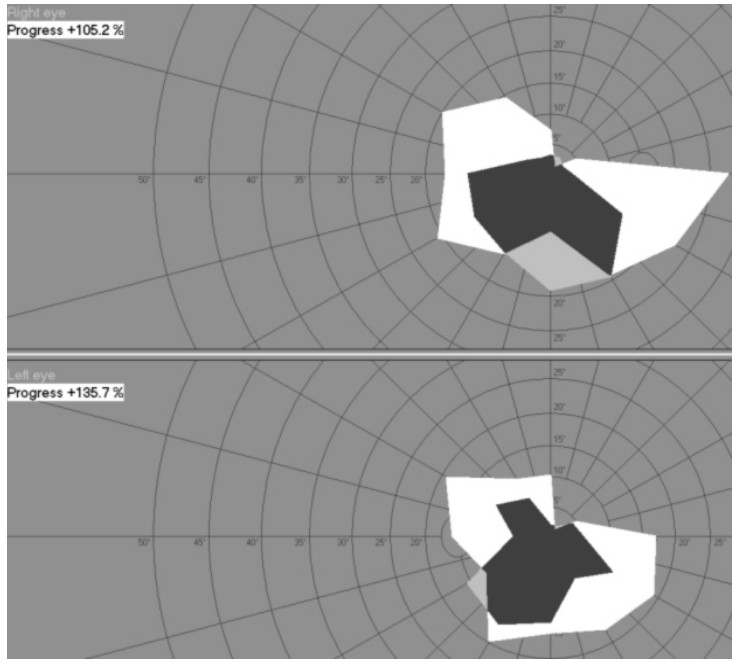

Figure 4. Percentage change in the white (form field) isopter between November 2023 and July 2024, demonstrating peripheral expansion.

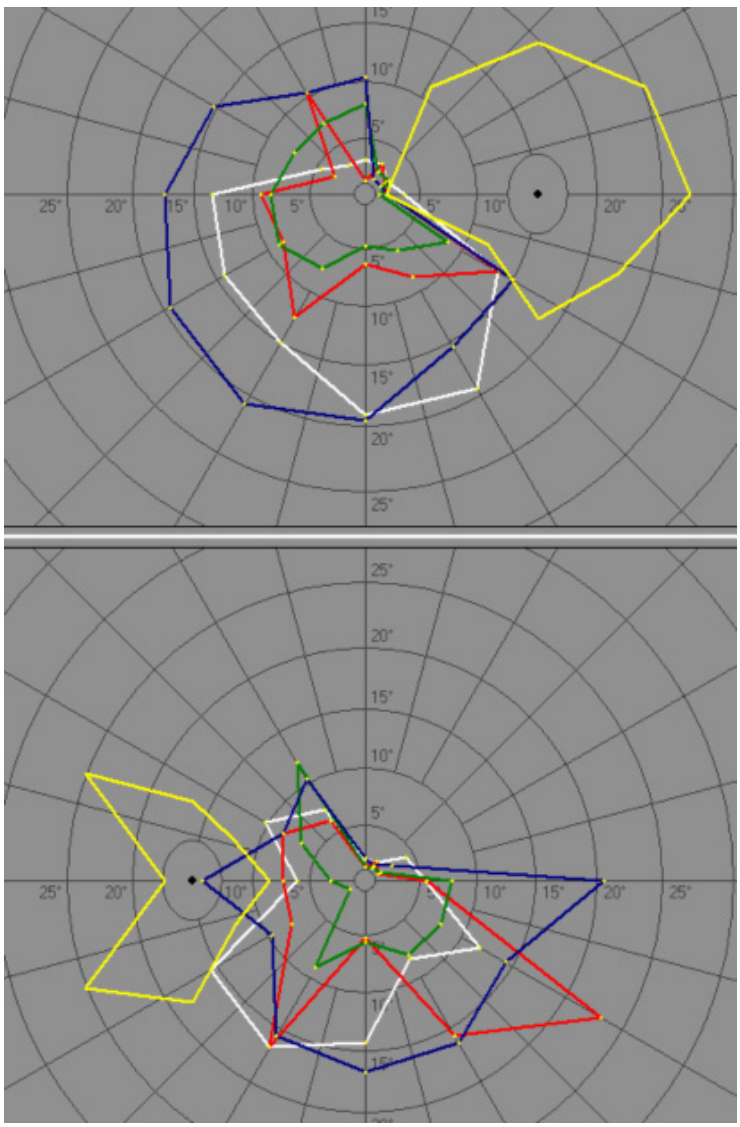

Figure 3 Initial FCFT results (right eye, top; left eye, bottom) demonstrating quadrantanopic field defects consistent with his HVF findings.

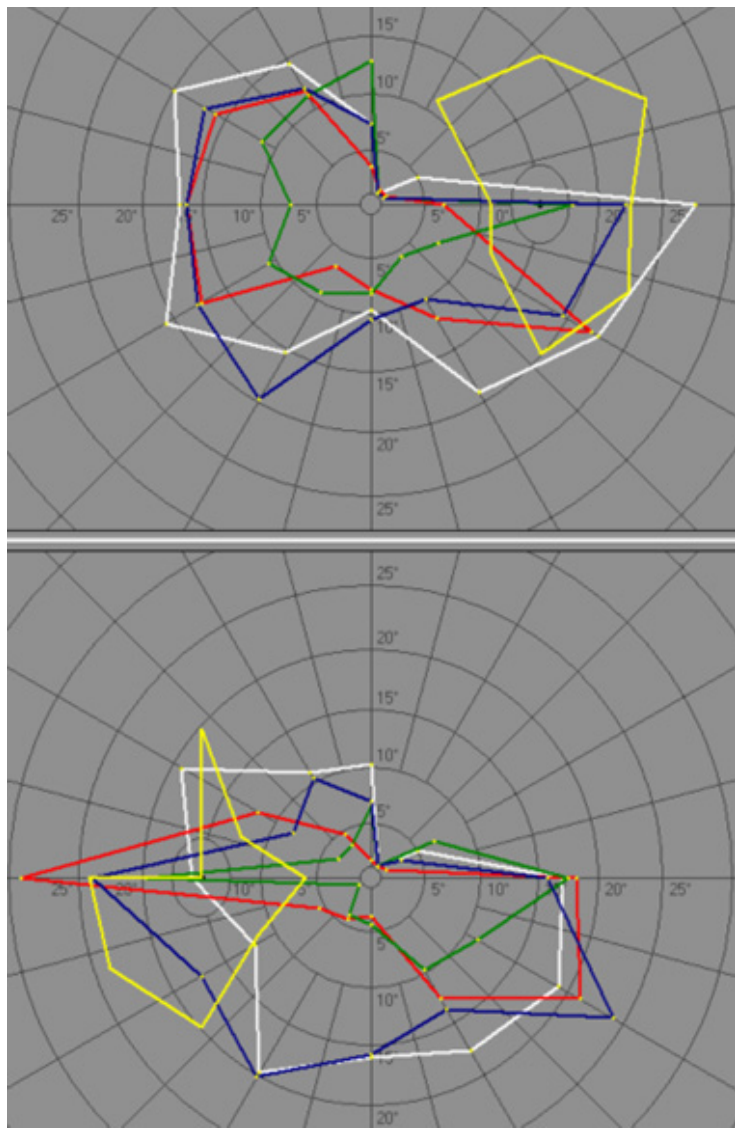

Figure 5. Final FCFT results after 14 weeks of NOR (right eye, top; left eye, bottom) showing an expansion of the horizontal and vertical meridians.

isopters appeared distorted and displaced, more prominently in the left eye. These distortions likely reflected altered visual midline perception associated with his field loss. Responses were restricted to the spared portions of the visual field, resulting in asymmetric isopter shapes. The isopter measurements are summarized in Table 1. Blind spot measurements were inconclusive due to the extent of the defect (Figures 3 and 5). Although blind-spot assessment is typically essential, it becomes unreliable when it overlaps with a scotoma.

A 14-week NOR program was initiated (outlined below), including both in-office and home-based therapy. Therapy targeted visuospatial awareness (x-y-z awareness), central-peripheral integration, saccadic scanning strategies, neuro-visual postural therapy (NVPT), and stereopsis training. Interventions included laser fixation goggles, yoked prism (axes 120° or 300°), movement-based activities, and syntonic phototherapy (SP). For his SP, he wore Pi Omega (blue/violet broadband wavelength filter) and Mu Upsilon (green/blue broadband wavelength filter) goggles (Hummingbird Hues Vision LLC, Avondale, CO, USA). He viewed a 6-watt LED light bulb (equivalent to a 40W incandescent) at 2700K from a distance of 16 inches at home, over a period of 6 weeks. WL's SP filters were an adjunct to his top-down NOR program. Visual field testing was repeated with the FCFT throughout the course of therapy.

Below is a summary of WL's NOR program with some specific examples:

Weeks 1-4

- Peripheral awareness mapping via Look Hard, Look Soft
  - He sat 20 inches from the whiteboard and fixated on a semi-reflective magnet. Instructions included either looking intently (view details within the magnet) or looking softly (simply noticing the magnet). As he fixated, this author slowly moved a red or blue marker from the center into the periphery until the patient no longer perceived the marker trail (ink, not the marker itself). We did this in various gaze positions to assess the functional differences between looking intently and looking softly.
- Peripheral look and touch
  - WL stood 1-2 feet from the whiteboard, focused centrally, then looked at a peripheral target in different gaze positions (e.g., 1-4 or 6-9). After 10 seconds, he refocused on the center and then reached out and pointed to the peripheral target. This peripheral point-and-touch method improves vision and proprioception, thereby increasing peripheral awareness.
- Peripheral X-taps
  - Like the activity above, but focusing on a central fixation while trying to touch the middle of the X on the whiteboard from the periphery.
- MacDonald chart
- Word Jam (iPhone game)
  - He worked on the working distance (e.g., z-axis) to improve near-based visuospatial awareness.
- Point of view driving video
  - He observed a driving scene and started moving by either walking or moving forward and backward in a computer chair.
- Column letter strip saccades
- VTS4 Multiple Choice Vergence, Road Race, and Vergence with Stereopsis 2
  - WL stood at 4 feet and performed the activity with various target sizes.
- Central-peripheral saccades
- Blind spotting training
- Cone of vision
  - He appreciated viewing objects on a wall as he moved back and forth from one foot to 10 feet. For example, there was an emergency exit sign in the upper right quadrant. The patient couldn't see it when his z-axis was compressed. As he extended his z-axis, he noticed expansion along the x- and y-axes. This activity improved his coping skills by helping him see around the visual field cut; he observed functional improvements in the grocery store, especially through increased perception of space with movement.
- Introduction to using yoked prism goggles (general expansion with base right, left, up, or down, and specific targeted areas with axes 120° or 300°).

Weeks 5-10

- Eye-hand coordination activities with yoked prism goggles
- Optokinetic nystagmusdDrum (manual or iPad version) in his peripheral field
- Look, point, touch (like earlier)

- Performed within usable areas of his 'hard' and 'soft' look mapping on the whiteboard.

Weeks 11-14

- Peripheral light flashing
  - WL sat in a dark room, looking at a laser pointer at the center of his vision. Then, this author flashed a flashlight across the visual field cut and worked on cultivating awareness and appreciation. Next, he placed the yoked prism glasses in different base positions (e.g., 120° or 330°). We also used a laser pointer and a swirling pattern in the periphery to stimulate motion detection.
- SVI Rotator
- Neuro-Visual Postural Therapy (NVPT) Activities
- Creating a stable base of support through vision
- Movement/walking-based activities
- Laser fixation exercises
  - He wore glasses with a laser in the middle. The author instructed WL to look straight ahead, then activated the laser. He noticed a mismatch between his perceived center—where WL looked to the left of the target when he believed his head was straight—and the actual central fixation. Neutralizing his perceived visual midline shift (VMSS) was accomplished with and without a prism.
- Peripheral catching with yoked prism goggles

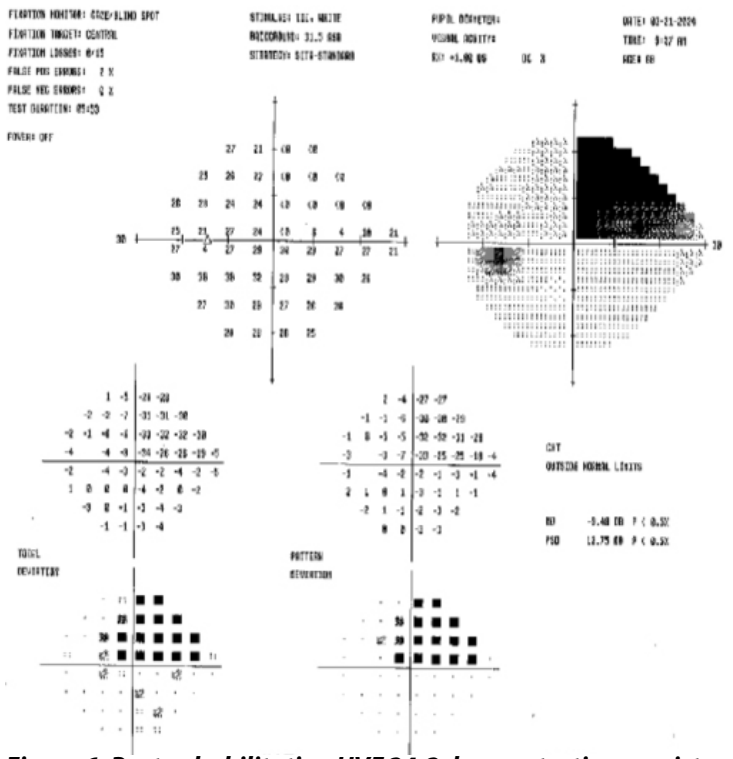

Figure 6. Post-rehabilitation HVF 24-2 demonstrating persistent quadrantanopia with mild improvements compared to the initial visual field.

Figure 4 highlights FCFT's unique recording capabilities, which demonstrate visible changes between sequential tests. At the same time that HVF showed minimal improvement (Figure 6), kinetic field expansion on the FCFT (Figure 5) correlated with WL's subjective improvements in balance and overall QOL.

It should be noted that FCFT introduces some variability, as patient performance can improve over time with enhanced peripheral awareness and central processing. Nonetheless, WL ultimately re-entered a driving program and successfully regained the ability to drive independently.

Discussion

Although spontaneous recovery may occur, many patients require therapy to improve function and quality of life.[8] Optical coherence tomography reveals thinning of the retinal ganglion cell layer in occipital stroke as early as six months.[9]

Although a 2019 Cochrane review found limited evidence supporting visual field rehabilitation, other studies highlight visual plasticity and the benefits of early, intensive therapy (three months versus six months).[8,10-12] While Laby[13] showed functional improvements despite visual field loss from a 14-week program, this case illustrates that NOR may also yield objective visual field recovery, even when begun more than six months post-stroke. Although not studied in the stroke population, SP offers a bottom-up approach to vision rehabilitation.[14] Additionally, filters in the blue end of the spectrum align with our retinal anatomy and potentially offer enhancement to peripheral processing.[4]

While the anticipated results for the FCFT are not considered normative due to statistical limitations, they provide a helpful comparison.[4] These results help contextualize WL's performance, which fell below healthy averages. That study also found age-related reductions in color isopters, particularly blue and green.[4]

Such changes, along with slower reaction times, must be considered when interpreting FCFT in older adults. Although WL's post-treatment values remained below average, he demonstrated improvements in 7 of 8 color isopters (Table 1). Both HVF and FCFT (Figures 5 and 6) continued to show a consistent

Table 2. Observed Percentage Changes in Each Color Isopter from Initial FCFT to End of Treatment (Red-highlighted values indicate decreases in visual field measurements. The negative values indicate a percentage decrease in the total area (cm^2) from one test to the next.)

Visual Field Measurements	November 2023 to February 2024	February 2024 to July 2024	November 2023 (Initial) to July 2024 (Final)
Right Eye White (Form) Red Green Blue	+145.0% +108.4% **-57.5%** +12.3%	**-16.2%** +31.6% +338.3% **-14.4%**	+105.2% +174.3% +86.1% **-3.9%**
Left Eye White (Form) Red Green Blue	+237.4% +104.8% +14.2% +63.3%	-30.2% -31.4% +55.6% **-7.3%**	+135.7% +40.6% +77.7% +51.4%

pattern of visual field loss, reflecting persistently constricted fields.

However, Table 2 highlights the longitudinal progression and variability of his functional fields, with expansion and compression commonly seen in clinical practice. These fluctuations may reflect attention, learning effects, or examiner-dependent fixation monitoring, although prior work suggests minimal inter-eye variation.[4]

Importantly, FCFT documented dynamic, incremental improvements not captured on HVF, with expansion across 7 of 8 isopters paralleling clinical gains in balance, anxiety, and independence. Other case reports also show increases in visual fields with the FCFT.[5,7] These outcomes, particularly for WL, underscore FCFT's value in linking visual field measures to real-world function, ultimately supporting WL's return to reengage in daily activities such as grocery shopping and driving.

Nevertheless, limitations include examiner-dependent fixation monitoring, the lack of formal test-retest data, and potential variability in reaction times. Future multicenter studies are needed to validate its reliability and establish normative databases, including stroke populations.

Conclusion

To our knowledge, this is the first documented use of FCFT in a stroke patient, demonstrating its value as a complement to static perimetry. Administering the test before, during, and after NOR efficiently highlights visual field changes often missed by static testing and enables ongoing monitoring to guide tailored interventions. Its use may help bridge the gap between objective field loss and functional rehabilitation outcomes. Broader adoption will require normative databases, multicenter validation, and further standardization in stroke rehabilitation.

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