Neuro-Optometric Rehabilitation Speeds Recovery in Traumatic Third Nerve Palsy: A Case Report

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Background

In a complete third nerve palsy, the eye is pulled **"down and out"** due to unopposed action of the lateral rectus (VI nerve) and superior oblique (IV nerve), often accompanied by ptosis and a dilated pupil[1][2]. Traumatic oculomotor nerve palsy causes acute binocular diplopia and strabismus, significantly impacting visual function[3]. Standard management of acute third nerve palsy is usually conservative – many patients show spontaneous improvement over **6–8 months**, during which symptomatic treatment (patching one eye or prism lenses) can relieve double vision[2]. If no substantial recovery occurs by about 6–8 months, strabismus surgery may be considered to realign the eyes[2]. However, **neuro-optometric vision rehabilitation** (a form of vision therapy) is emerging as an active intervention to enhance recovery of binocular vision in cranial nerve palsies[4]. Vision therapy involves therapeutic eye exercises and neurosensory stimulation aimed at improving eye muscle control and neural integration. It has been reported to help some third nerve palsy patients regain eye movement range and binocular fusion more quickly[4]. Research from the University of Rochester (published in *Brain*) underscores that **"time is vision"**—visual capabilities may decline over months after occipital stroke, and **earlier visual training (e.g., within the first 3 months) can improve recovery efficiency** compared with later intervention [6].

This poster presents a case of traumatic third nerve palsy in which early neuro-optometric rehabilitation was associated with accelerated and robust improvement in ocular alignment and function.

Case Description & Optometric Examination

Patient: 25-year-old male, 1 month post **motor vehicle accident** (cerebral concussion on Jan 19, 2024). He reported one week of blurry vision and horizontal diplopia (noted Feb 18, 2024). He also noted his right eyelid was initially droopy in the ICU after the head injury, but the ptosis improved by mid-February. The patient was referred by a strabismus specialist ophthalmologist for co-management. She would like the patient to try a non-surgical approach first.

Examination (Mar 5, 2024): The patient was alert, oriented, and had no abnormal head posture. Key exam findings included:

- **Right eye exotropia:** The right eye was deviated outward at rest (exotropic). No ptosis was present by this exam (right upper lid fully open).
- **Ocular Motility:** Marked limitations in right eye movements: *adduction* (inward movement) was severely limited (-4 on a 0 to -4 scale, indicating almost no movement), with **limited elevation** (-3) and **depression** (-4) of the right eye. Abduction (outward movement via lateral rectus) was intact. The left eye had full range of motion. Figure **1A** shows a typical presentation of restricted adduction in a right third nerve palsy. The patient was unable to converge with the right eye (failed convergence on attempted near focus).
- **Diplopia:** He had binocular diplopia in primary gaze; covering either eye eliminated the double vision. He subjectively reported seeing double for both distance and near.
- **Pupils:** Right pupil was ~5 mm and **sluggishly reactive**, left pupil ~3 mm and briskly reactive. (The dilated, sluggish right pupil indicated partial parasympathetic involvement of the III nerve.)
- **Visual Acuity:** Uncorrected Snellen acuity in OD: 6/15 , **6/6** in OS individually, but together his vision was functionally reduced due to double vision (he could not fuse images). Near vision was N4.5 in the left eye, and slightly worse in the right (N24 at 40 cm, improved to N12 with pinhole).
- **Sensory tests:** He lacked **stereopsis** (no depth perception on stereo tests) and showed suppression on Worth 4-Dot (he saw only 3 green lights at both distance and near, indicating the right eye's image was being suppressed to avoid diplopia). Color vision was unexpectedly poor (he failed 3/17 Ishihara plates with the right eye), possibly due to testing difficulty or a pre-existing mild color deficiency – there was no structural optic nerve damage noted.
- **Ophthalmic health:** Anterior segment was normal (clear corneas, deep anterior chambers, clear lenses) and dilated fundus exam was unremarkable (healthy optic nerves with 0.3 cup-to-disc, flat retina, no hemorrhages). Neurological imaging (CT brain) had been done at the hospital; no compressive lesion was reported (findings consistent with post-traumatic nerve palsy).

Diagnosis: Traumatic **right oculomotor nerve (CN III) palsy** secondary to closed head injury (concussion from the MVA). This was a **partial third nerve palsy with pupil involvement**, resulting in an exotropia and inability to elevate, depress, or adduct the right eye. The clinical picture matched a post-traumatic third nerve paresis (down and out eye, diplopia, partial ptosis resolved, and a dilated pupil)[1]. Notably, this patient's third nerve palsy was not microvascular (ischemic) but trauma-induced; recovery in such cases is variable and often incomplete without intervention[5].



Figure 1A :March 2024



Figure 1B : July 2024

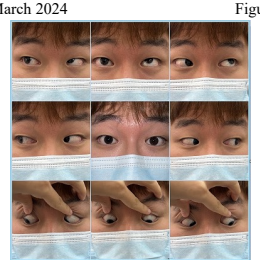


Figure 1C : Jan 2025

Neuro Optometric Vision Rehabilitation Intervention

Given the potential for neural plasticity, the patient was referred in March 2024 for **early neuro-optometric rehabilitation therapy** rather than waiting passively for spontaneous recovery. The rehabilitation program was overseen by a neuro-developmental/behavioural optometrist and tailored to address the specific deficits in this patient. The therapy aimed to **speed up re-establishment of binocular single vision** by improving the strength and coordination of the affected eye muscles and enhancing sensory fusion.

Key components of the patient's vision therapy program included:

- **Oculomotor Exercises:** The patient performed guided eye movement exercises to improve pursuit (tracking) and saccades. This included having the patient practice moving the eyes smoothly in all directions and quickly between targets. Initially, right eye movements were very deficient (especially moving inward and upward), so therapy emphasized stimulating those restricted gaze movements. Over 5 weeks, the range and accuracy of the right eye's motions improved (as reflected later by pursuit/saccade grades improving from 4/2/4/4 to 5/5/5/5 in all fields).
- **Vergence Therapy:** Convergence exercises were a major focus to overcome the exotropia. The patient practiced **convergence training** using tools like a vectorgram, VTS4 , brock string. **Brock string therapy** involves focusing on beads at various distances along a string to build convergence ability and awareness of both eyes' alignment. As therapy progressed, the patient's near point of convergence (NPC) improved dramatically – from an inability to converge at all (in March) to being able to converge "to the nose" repeatedly by July 2024. His NPC continued to improve, later measuring 4 cm and then 2 cm (break point) on follow-up, well within normal limits.
- **Fusion & Stereopsis Training:** To retrain the brain's ability to fuse the two eyes' images, the patient engaged in binocular fusion activities. This included use of **Worth 4 Dot** and red-green anaglyph exercises for anti-suppression, as well as stereogram cards and computer orthoptics (VTS4) to stimulate depth perception once alignment improved. Initially, he was suppressing the right eye to avoid double vision, but therapy helped him to start using both eyes together. Over time, Worth 4-Dot testing went from only 3 dots (suppression) to a normal 4-dot fusion response at both distance and near (by the 4-month visit).
- Stereopsis (depth perception) was absent initially. After 4 months of therapy, he achieved gross stereopsis of about **100 arc-seconds**, indicating restored binocular depth perception (e.g. he could appreciate 3D shapes on stereo tests at 100" level). This confirmed functional binocular vision was regained, though fine stereoacuity was still improving.
- **Accommodation:** Because the third nerve also affects the focusing (accommodation) via the ciliary muscle, therapy included accommodative exercises and lens activities. These exercises (like focusing on near/far targets, accommodative flippers) were intended to normalize any focusing lag in the right eye and to coordinate accommodation with convergence. The patient's near visual clarity improved (right eye near acuity improved from N24 to N4.8 by July 2024 without correction). Additionally, therapy incorporated balance and vestibular integration techniques (e.g. moving targets, head movements during eye tracking) to ensure the visual gains would translate to daily life activities without dizziness or disorientation, which can occur after TBI.

Therapy sessions were conducted **weekly during the first 1–2 months**, supported by **daily home exercises**. The patient remained **highly motivated and fully compliant** throughout the program. After the initial period, **no penalization (patching)** was used; instead, treatment emphasized **active use of both eyes as soon as feasible** to promote **binocular fusion**.

Importantly, the patient did **not** undergo **strabismus surgery** or receive **botulinum toxin**. The care plan prioritized **natural nerve recovery** combined with **neuro-optometric vision rehabilitation** to restore alignment, with surgery reserved only if a **significant deviation persisted beyond 6–8 months**.

Outcomes & Results

Alignment & Ocular Motor Function: The patient's ocular alignment improved substantially with rehabilitation. At the 4-month review (July 2024; Figure 1B), his distance alignment had normalized to orthophoria (no manifest deviation at 6 m), improving from the initial large exotropia. At near (30 cm), he demonstrated only a small exophoria (latent outward drift) rather than a constant exotropia. Clinically, this reflects a shift from a constant right exotropia at near to a 6Δ exophoria that he could control with convergence. Functionally, he was able to maintain single binocular vision for near tasks, with only a mild tendency for the right eye to drift outward when fatigued.

Extraocular motility improved in parallel. By July 2024, motility testing showed an almost full range of right-eye movement. The earlier limitations in adduction, elevation, and depression improved largely from –3/–4 to minimal residual restriction, persisting only with right elevation. This was supported by pursuit and saccade assessments, which had returned to normal in all directions by 4 months. The patient also reported no diplopia in primary position or reading gaze and experienced comfortable single vision in daily activities.

Visual Acuity: The patient's visual acuity remained high in both eyes. The initial mild decrement in right eye acuity (6/15 uncorrected, no improvement with pinhole) resolved once binocular function was restored. After rehab, his uncorrected acuity was 6/6 OU (20/20 in both eyes) at distance and N4.5 at near. Minor refractive changes were found (approximately +0.50 D hyperopia in the left eye and a minor astigmatic shift in the right), but these were small and did not require a full-time prescription; Importantly, the restoration of binocular vision contributed to perceived clarity – initially he "saw double" with both eyes (effectively reducing functional acuity), but by the end he saw single and clear images. **Color vision has improved**. Patient correctly identified 17/17 plates and passed the test.

Sensory Fusion & Stereopsis: As of the July 2024 exam, the patient passed the Worth 4-Dot test (fusion lock achieved) at distance and near, confirming stable sensory fusion. Stereopsis testing showed **stereoacuity of 100 arc-seconds** on the Titmus test (he could identify the 3D forms at that level, such as the fly's wings, though finer stereo targets like 40" were not yet appreciated). He also demonstrated gross depth on the Frisby test (170–215" range). This represents a substantial improvement from zero stereo, and is indicative of functional depth perception sufficient for most daily tasks. The stereo continued to improve gradually with ongoing practice and as motor alignment stabilized; by Jan 2025 (Figure 1C), the patient reported depth perception felt almost normal in real-world settings.

Vergence Ranges: Objective fusional vergence reserves increased significantly, reflecting the patient's improved ability to maintain alignment under binocular stress. For example, at the 4-month mark his positive fusional vergence (BO) at distance was measured with prisms – he could converge to overcome about 30Δ base-out prism (break at ~31Δ, recovery ~19Δ), whereas initially any attempt at convergence caused immediate double vision (no measurable range). His negative fusional vergence (BI) at distance also became measurable (~17Δ break). These ranges fluctuated at later visits but remained within normal limits, indicating that the patient's visual system developed enough flexibility to comfortably fuse at distance and near despite a history of nerve palsy. The near vergence ranges similarly improved; by Jan 2025 he could fuse through base-out prisms well above 40Δ at near, showing robust convergence ability. This objective finding supports the functional observations that he was able to maintain single vision even when tired or focusing on near work for long periods.

Pupil and Eyelid: The right pupil, which was initially sluggish and enlarged, showed some improvement in reactivity over time. By the July 2024, the anisocoria had reduced – the right pupil was closer to the left in size under ambient light, and reaction to light improved (though still mildly slower than the left). This suggests partial recovery of the parasympathetic fibers in the III nerve. The patient did not experience any recurrence of ptosis; his eyelid position remained normal. No aberrant regeneration signs (e.g. aberrant lid elevation or pupil constriction on gaze) were observed – often a good prognostic sign that the nerve healed relatively cleanly.

Subjective Outcome: By the July 2024, the patient reported **complete resolution of diplopia** in daily life. He was able to return to driving and computer work without double vision. Reading and near tasks were comfortable with both eyes. He subjectively rated his vision as back to normal. Importantly, this recovery occurred *well in advance* of the typical natural history timeline. Many traumatic third nerve palsies would still be significantly misaligned at 4–6 months post-injury[2], whereas this patient achieved single, aligned vision by 4 months. He did not require any strabismus surgery. At the latest follow-up (Jan 2025, about 17 months post-injury), his binocular status remained stable with no regression – indicating that the improvements gained through vision rehabilitation were lasting.

Discussion

This case illustrates the potential benefit of **early neuro-optometric vision rehabilitation** in a cranial nerve palsy. Traumatic oculomotor palsy in a young adult typically poses a rehabilitation challenge: while partial spontaneous recovery is possible over 6–12 months, outcomes are variable and often incomplete[5]. During the natural recovery period, patients endure disabling diplopia, and prolonged misalignment can lead to suppression or impaired depth perception. Traditional management in such cases focuses on observation and symptom management (e.g. patching) until either spontaneous improvement occurs or surgical intervention is undertaken[2]. In contrast, active vision therapy provides the patient with neurosensory and neuromotor stimulation that may **accelerate neural recovery and functional compensation**. Research from the University of Rochester, published in *Brain*, emphasizes that "time is vision." After an occipital stroke, visual abilities may continue to decline over subsequent months, and starting visual training earlier—such as within the first three months—can improve recovery efficiency compared with later intervention.[6]

In this case, beginning structured Neuro Optometric vision rehabilitation just weeks after the injury likely helped engage the patient's visual system during the critical healing phase. By practicing building back the foundation of visual functional skills such as pursuit, saccade, convergence and reinforcing binocular fusion daily, the patient "retrained" neural pathways to use the recovering right medial rectus muscle as soon as possible. This early stimulation could have prevented suppression from becoming permanent and encouraged the restoration of central fusion. Furthermore, targeted eye movement exercises might have minimized contracture of antagonistic muscles (like the lateral rectus) and kept the ocular motor range flexible during nerve regeneration. The result was a faster realignment than expected – orthophoria achieved in 4 months – and the development of functional binocular vision, including stereopsis.

It is important to acknowledge that some degree of the improvement was due to natural nerve healing; traumatic nerve palsies can partially recover on their own given time. However, the **quality** of the recovery in this patient (nearly normal vergence ability, stable fusion, and no need for surgery) points to the significant role of the rehabilitation exercises. Neuro Optometric Vision rehabilitation specifically addressed aspects of visual function beyond just eye position – it trained vergence facility, accommodation, and binocular integration, which pure surgical alignment alone cannot restore[2][4]. For example, even if the nerve had regenerated to allow some eye movement, without therapy the patient might still have struggled with convergence insufficiency or residual diplopia due to central fusion disruption.

The therapy protocol in this case aligned with recommended neuro-optometric strategies for nerve palsies: **developing fusional vergence ranges, enhancing convergence/accommodation relationships, and restoring stereopsis**. These goals were achieved as evidenced by the patient's measured improvements in those domains. Indeed, neuro **optometric vision rehabilitation is reported to be an effective treatment option for some third nerve palsy patients**, helping to improve eye movements and binocular vision without surgery. Our case supports this, demonstrating that a combination of modern vision therapy techniques can lead to excellent functional outcomes in a traumatic III nerve palsy.

Another notable point is the safety and patient experience: the patient actively participated in his recovery, which may have psychological benefits compared to passive waiting. He regained confidence in his vision sooner, which likely improved his overall rehabilitation from the head injury. No adverse effects occurred from the vision therapy aside from temporary eye strain during early sessions. This suggests that for similar cases (especially in young, motivated patients), early neuro-optometric rehab is a low-risk intervention with potential high reward.

Conclusion

Early neuro-optometric vision rehabilitation played a pivotal role in this patient's remarkable recovery from traumatic third nerve palsy. By actively engaging the visual system through customized therapy exercises, the patient achieved realignment and functional binocular vision **months ahead of the typical natural course**. He regained full ocular motility, single vision, and stereopsis, thereby avoiding prism dependence or surgical intervention.

This case exemplifies how neuro-optometric vision rehabilitation can **accelerate neural recovery and improve outcomes** in cranial nerve palsies, beyond what spontaneous healing alone might accomplish. For clinicians managing acute third nerve palsy (particularly in cases of head trauma), this approach highlights an effective, non-surgical treatment avenue. Integrating vision rehabilitation early on can shorten the duration of diplopia and hasten the return to normal visual function, greatly benefiting patient quality of life. A University of Rochester study published in *Brain* highlights that "time is vision."

Following an occipital stroke, visual function may worsen over the ensuing months, but initiating visual training early—ideally within the first three months—can lead to more efficient recovery than delaying intervention.[6] Further studies and increased awareness of neuro-optometric rehabilitation will hopefully establish it as a standard adjunct in the multidisciplinary management of complex ocular motor palsies.

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