ORIGINAL STUDY

The Future of AI in Clinical Decision Support for the Neuro-Optometrist

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ABSTRACT

A retrospective pilot study was performed to look at the relationship between real life clinical neuro optometric vision therapy protocols performed by a group of licensed optometrists and treatment plans created by an artificial-intelligence (AI) model configured with neuro-optometric data, and related published text. The ultimate goal would be to create a widely used tool to help guide a rehabilitation team toward better treatment outcomes. It could help them decide if vision therapy is indicated for a patient and what types of therapy would be useful. We analyzed historical patient data (n= 8) to gather patient profiles, prescribed treatment plans, and patient outcomes. The patient profiles were input into the AI system, which generated personalized treatment protocols and predicted patients' outcomes. We compared the similarities between the clinician prescribed protocols and AI generated treatment plans. We also looked at how the AI suggested treatments and predicted outcomes compared to the actual patient outcomes. The AI model showed a strong agreement with the clinician strategies and, in some cases, identified additional treatments supported by peer-reviewed research. It also recommended collaborating with other professionals for the overall recovery of the patient. The findings indicate that AI-based neuro-optometric systems can mimic important aspects of expert clinical reasoning and may offer a scalable way to improve diagnosis, treatment, and patient access to neuro optometric vision therapy.

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INTRODUCTION

Oculomotor dysfunction and subsequent vision therapy techniques have had a strong role in injury recovery in a wide array of settings. Early findings of war time injury had a high incidence of coexisting visual dysfunction. Following the conflicts in Iraq and Afghanistan, studies of service members with mild traumatic brain injury (mTBI) demonstrated a high prevalence of visual dysfunction, with approximately 60-75% exhibiting oculomotor, accommodative, or binocular vision abnormalities.[1-3] Meanwhile, concussion management in sports medicine and neurology largely emphasized physical and cognitive rest until symptom resolution.[4]

Beginning in the early 2000's, renewed attention to visual dysfunction following traumatic brain injury, driven in part by military studies from the VA (Veterans Affairs) and DoD (Department of Defense), contributed to increased use of neuro-optometric rehabilitation. Contemporary programs incorporated computerized training systems, quantitative outcome measures, and multidisciplinary approaches that extended beyond traditional orthoptic exercises to include broader cognitive and rehabilitative interventions.[1,3,5] Some of these computerized programs include Vision Therapy System 4 (VTS 4), Sanet Visual Integrator (SVI) and

Neurotracker which provided much better metrics and data for more quantitative data points.

These newer programs feature a great many data and decision points that would be greatly assisted with the use of Large Language Models (LLM). The authors have explored this concept in "Using Large Language Models in Neuro-Optometry Rehabilitation Program."[6] The paper suggests the development of a "Rehabilitation Database". This database would be the exclusive source of relevant clinical information that the LLM would query to generate informed answers to rehabilitation clinicians.

Further work on a rehabilitation database led to the hypothesis of this pilot study. Namely, that AI models will be able to suggest appropriate treatment plans along with additional suggestions for complementary interdisciplinary recommendations for better recovery outcomes.

MATERIALS AND METHOD

The study design is a retrospective observational pilot study with de-identified records. The data input was de-identified patient records from the Edmonds Eye Associates Vision based Neuro Rehabilitation practice in Philadelphia, Pennsylvania.

Inclusion criteria included:

- Patients that were involved with some type of mTBI
- Patients that had enough sessions to interpret their outcome
- Patients that had a known outcome

Exclusion criteria included:

- Patients that had visual dysfunction related to anything other than mTBI, such as migraines suffers, or native convergence insufficiency
- Patients that were frequent no shows or refused clinical recommendations
- Patients that were lost to follow-up for any number of reasons

The Large Language Model (LLM) was a custom, proprietary version of Chat GPT-5 (Generative Pre-trained Transformer-5) (Open AI). The LLM was pointed to a private rehabilitation database of specific Neuro-Optometric content.[7-11] The LLM exclusively queries this database to answer clinical questions posed by the user. The information that was input into the LLM was a full printout of a patient's deidentified initial comprehensive eye examination and binocular vision evaluation. The only prompt given was simple: "Generated personalized treatment protocols and predicted patient outcomes". The cases were uploaded one after another and the model analyzed and provided output as seen in Addendum A.

The model did not have any access to outcomes, treatments, or progress notes, only the initial evaluation. The output was not refined for this pilot study, although the model is certainly capable of follow-up questions and additional information. There was no blinding of reviewers during this retroactive pilot study, but rather a comparison between the output and the actual patient outcomes.

Ethical Considerations

This pilot study involved a retrospective analysis of existing clinical records that were fully de-identified prior to analysis in accordance with the HIPAA Privacy Rule Safe Harbor method (45 CFR §164.514). No protected health information (PHI) was used, and no patient contact or intervention occurred. As such, this study did not constitute human subjects research under 45 CFR §46.102 and was exempt from Institutional Review Board (IRB) review under 45 CFR §46.104(d)(4).

Results:

Treatment Comparisons:

Review addendum A for full AI output

Case 1

The actual treatment course for this patient was a total of 11 sessions with a full recovery back to baseline visual comfort, and return to normal school activities documented. Initial sessions started with convergence, divergence, saccade, pursuit and accommodation therapies. They progressed to add in jump vergences and the other exercises'

difficulties were increased at each session. After 4 sessions Neurotracker was added and difficulty was increased session to session.

Overall, the actual therapy that was administered very closely follows what the AI model recommended. It recommended a three-phase approach estimating 16 weeks of therapy starting with stabilization and autonomic calming, followed by oculomotor and binocular integration, followed by functional load and school stimulation. The real-world therapy merged the phases together rather than separating them. The timing was very close to the prediction as well as the overall outcome.

Case 2

The actual therapy spanned 6 sessions. Initial session started with VTS hololens base in and base out, and basic saccade and pursuit training. Accommodation and jump vergences were quickly added and the speed and reaction times were quickly ramped up as they tolerated the sessions very well. Neurotracker was added and ramped up quickly as well. The quicker the patient was able to get through the exercises the more we added to keep them engaged and keep the progress momentum.

The AI model recommended the three-phase approach spanning 16-20 weeks with binocular calming and work integration. AI also suggested we add functional binocular stability including store aisle simulation tasks, visual motion desensitization. Although we did not add functional binocular stability this could have been beneficial for this patient. This was likely done on their own and they were able to return to full-time work. The predicted timeline was longer than needed in real-world recovery. The patient was able to return to their full baseline and did not require ongoing treatment.

Case 3

Actual therapy sessions totaling 5 sessions. The initial VTS hololens targets had to be non randot targets as they were unable to appreciate Random dot stereopsis (RDS) targets. They were only able to tolerate one round of base in and base out exercises. Saccade and pursuit activities were minimally tolerated. Session 2 was much better tolerated, and difficulty was increased gradually. Neurotracker was introduced after session 3.

The AI generated plan demonstrated its ability to conceptualize the overall therapy and break it up into phases of therapy. It recommended 12-16 weeks. Phases include visual efficiency stabilization; binocular and oculomotor endurance followed by functional integration and return to load. Recommendations included fluorescent light desensitization and extended reading simulations. This is typically something that would be recommended for the patient to do outside of therapy such as taking laps around the grocery store without actually shopping or working their way up from short passages in magazines and working toward longer books or increasing screen time. The expected outcomes were true to the real outcome.

Case 4

This patient had a total of 4 sessions before taking an extended break from therapy and then returned for 8 additional sessions. They were not discharged from therapy but ended up stopping attending sessions. This case was complicated by their need to attempt to return back to work or lose their job.

Their sessions started with free space activities to establish any type of binocularity and basic saccades and pursuits. When they returned after their extended break from therapy we started into VTS 4 hololens with maximum depth of field settings. This was tolerated but they were unable to keep consistent sessions to build any momentum. The patient ultimately returned to work but was unable to keep their position due to their ongoing symptoms.

The AI model predicted 20-24 weeks of therapy. It breaks down therapy into neurovisual stabilization and safety, then binocular re-establishment and oculomotor control, and finally function integration and mobility confidence. It made good recommendations for a slow and steady recovery as well as an accurate guarded prognosis.

Case 5

This case had a total of 9 sessions with a full recovery to baseline visual function. They were very eager to get better and push through their discomfort. We started with VTS 4, hololens, saccades and pursuits. We quickly escalated to adding jump vergences, central fixation, and balance board complexities during pursuit and saccades exercises as well as Neurotracker.

The AI model predicted 12-14 weeks of therapy. Phases included visual comfort and stability, then binocular and oculomotor endurance, followed by functional integration and driving confidence. It went with a more conservative approach whereas real world therapy was able to advance much more quickly.

Case 6

This case had a total of 9 sessions. Sessions began with VTS 4 and SVI with base in, base out, saccades and pursuit training. Difficulty was increased as tolerated by the patient. They graduated from therapy with ongoing headaches and some cognitive delay which they will be seeing cognitive therapy and their neurologist to further explore.

The AI model recommended 14-18 weeks of therapy. Its phases included headache reduction and binocular calming, then binocular stamina and oculomotor efficiency finishing with functional load and screen reintegration. The plan was similar to real world therapy.

Case 7

The total therapy sessions for this case were 6. Therapy started with RDS targets for base in and base out, and SVI for saccades and pursuits. We progressed through and added jump vergences, central fixation during saccades and pursuits, as well as use of a balance board through the exercises.

The final piece of the therapy was to update the glasses prescription.

The AI generated a well-constructed and appropriate management plan for this patient. It started with photophobia reduction and visual comfort followed by binocular and oculomotor endurance finishing with functional workplace integration. It recommended many additional tasks that could have been given for homework to reinforce the in-office therapy.

Case 8

This case had a total of 6 therapy sessions. Therapy started with VTS hololens with base in and base out activities as well as SVI for saccades and pursuits. Neurotracker was added toward the end of therapy to work on visual processing integration.

AI spaced out the phases much more than was actually performed in this case. It recommended 10-14 weeks of therapy. It recognized the surgical limitations and planned accordingly. Phases started with binocular awareness and stability, followed by binocular coordination and endurance finishing with functional binocular integration.

DISCUSSION

The AI model was able to largely replicate the treatment protocols of the experienced licensed optometrists. The recommendations based on the evaluation findings as well as the predicted timeline is what we find to be the standard of textbook cases of the diagnoses that were determined. The timelines in our Vision Based Neuro Rehabilitation were somewhat shorter, however, it is likely that in a more traditional vision therapy practice model, where the therapist does therapy without the doctor's direct involvement at each session, would likely be closer to the textbook predicted time frames. As the model could be continuously trained, the outcome times could be more accurate the more data the model has about a particular practice. For this pilot, the model was not given any additional information other than the published text.

Chat GPT-5 was chosen for the LLM due to its ease of use, both on setting up a model that can only reference selected data, as well as being conversational and easy to understand. Other LLMs can reference select data sets but as their training is less broad, the conversational aspects of the responses are limited.

Chat GPT-5 is not without its limitations. It was not trained on any set number of patients as this is still in its early stages of development. If Chat GPT-5 is to be used further there will need to be significant time spent on fully training the model to reduce errors and hallucinations.

LLMs also cannot account for patient variability. Some patients are motivated to push through therapy sessions while others struggle with underlying depression or other metal health issues and are overwhelmed by simple therapy sessions. Finances can play a role in therapy regardless of motivation. The plan of treatment is always fluid and needs to be updated accordingly. Any LLM is not going to be able to predict human issues and therefore must remain as the assistant to the human clinician.

Chat GPT 5 can be praised for its ability to simplify complex medical terminology but can often get abbreviations incorrect and can misinterpret data.[12] The clinician must always challenge any LLM and verify the source of conclusions or recommendation. ChatGPT-5 is also known to come to plausible conclusions, but with further investigation may find the conclusion is incorrect.[13]

Chat GPT 5 was also able to recommend additional strategies that could easily be integrated into future cases to help move things along even quicker and more efficiently.

At the heart of therapy, the doctor alongside a well-trained vision therapist can make a huge impact in a patient's recovery along with the information recommended from a LLM. Good therapists are well trained to make subtle changes to the therapy protocols during each session such as:

- Increasing or decreasing depth of field
- Increase or decrease target size and speed
- Adding or removing central fixation targets
- Adding or reduce complexity of the targets used such as incorporating letters and numbers, capital or lower case, or changing the targets images to alter the clues to depth perception.
- Add in or remove the balance board depending on the active symptoms or presentation of the patient that day

We use a standard protocol at each session to evaluate all eye movements. We sometimes find eye movement deficiencies that were not noted in the initial evaluation. Once these are discovered, the therapy sessions are adjusted to address all areas of weakness.

In office sessions are scheduled weekly for 45-minute sessions where 30 minutes are face to face with the therapist and the 15 minutes are face to face with the treating optometrist. Exact time on each individual exercise is determined at the time by the therapist based on entering symptoms that day, motivation level, historical time to recover, etc. More time may be spent on more difficult areas for any particular patient with multiple different strategies per session. Homework is offered at times to reinforce tasks but is often unnecessary when recovery is moving along quickly. We have found that daily activity among a patient's already busy schedule of other therapy is often enough to reinforce the techniques worked on during the in-office sessions.

Clinical implications for using this AI assisted treatment program in a real-world clinic would need to factor in HIPAA compliance, the skill level of the therapist, and the equipment available in the clinic.

Limitations to this paper include a retrospective design, a small sample size and a single practice. The books uploaded to the model are limited to the contributing authors' real world experience, referencing material, as well as years of practice, but may differ from others' real world experience.

FUTURE IMPLICATIONS

The amount of literature that is uploaded into the model can further expand its capabilities. There is the potential to incorporate the AI model directly into EHR systems to keep information HIPAA compliant and streamline the recommendation process. Many EHR systems are beginning their journey to incorporate AI. These systems are in their infancy and need more work to incorporate AI generated suggestions that the human clinician may adapt or modify to plan out each case. Currently most EHRs are only focused on quicker

and more accurate data entry. AI models however are capable of much more.

Attempts have been made to integrate multiple offices and specialties to share patient data and progress notes. Most offices still rely on fax transmissions to share this data. Hopefully the AI systems will find a more robust way to integrate the data and be able to summarize it in a way that is understandable for different specialties. If the physical therapist can automatically generate an AI summary into the optometrist EHR and vice versa then a patient that is working on vestibular and vision therapy could have better complimenting therapy protocols to help in the overall recovery.

For the study, the next steps would be a prospective study, adding in clinic specific data such as the type of equipment available and the expertise level of the therapist as well as adding additional literature to the AI model. There is the concern of giving too much data and may be conflicting therefore confusing the model. A double-blind study could further solidify the power of the AI model to compare speed of recovery as well as resources needed to have excellent patient outcomes.

CONCLUSION

This AI model has the ability to point the doctor and therapy team in the right direction. This would include setting up a therapy protocol for each patient and predicting possible outcomes and timelines. This model could be used for an optometrist that already performs therapy in their office to help them think more thoroughly through their treatment plans. This could result in better outcomes for their patients. It could also be used for a therapist that is looking to expand their knowledge and process through more challenging cases. The model could also help an optometrist get their feet wet with therapy and build a therapy practice more quickly and efficiently than without it. The model could also be adjusted to the specifics of the therapy environment to increase or decrease projected timelines based on how a practice chooses to deploy their therapy. It could also consider the type of equipment available or what kind of multi-disciplinary team is available in the area the therapy is taking place.

As good as any of these LLMs are at this time, they cannot be relied upon for clinical decision making. They are only a tool to assist a licensed doctor to consider, adapt and implement for any specific patient. LLMs focused on a good rehabilitation database can be an important tool to make a busy clinician think deeper about each case and bring up ideas that may have otherwise been overlooked. Often a team of doctors will sit down and go over cases together and bounce ideas off each other. This trained LLM can be a valuable assistant for the team and provide and interpret data without the time and resources that would otherwise be required.

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Dr. Chad Edmonds is an optometrist and practice owner in the Philadelphia area with a clinical focus on neuro-optometric rehabilitation, vision therapy, and primary eye care. He is a member of the staff at Magee Rehabilitation Hospital and Bryn Mawr Rehabilitation Hospital where he evaluates and manages visual dysfunction associated with concussion, traumatic brain injury, stroke, binocular vision disorders, and other neurologic conditions.

Dr. Edmonds is a 2017 Graduate of the Pennsylvania College of Optometry at Salus/Drexel University where he was recognized with awards for excellence in Primary Care and Low Vision.

Dr. Edmonds is actively involved in exploring the integration of artificial intelligence into neuro-optometric clinical decision-making. He has co-authored papers on the use of Large Language Models for Neuro-Rehabilitation and Vision Based Neuro-Rehabilitation.

AI output:
Below is a **personalized, vision-centered neuro-optometric rehabilitation plan and predicted outcome** for this patient, derived only from the uploaded clinical record and the Neuro-Optometric Rehabilitation reference files you provided, in alignment with your Concussion GPT rules.

CASE 1: 14-Year-Old Male — Post-Concussion Visual Dysfunction
Dx:
- Concussion with brief LOC
- Convergence insufficiency
- Deficient saccadic eye movements
- Accommodative spasm
- Light sensitivity / autonomic instability

(Clinical findings summarized from the ABI evaluation)

CLINICAL PATTERN RECOGNITION
Primary Dysfunction Clusters
Based on testing and symptom surveys, this patient demonstrates a **classic post-concussion visual fatigue pattern:**

1. **Oculomotor Dysfunction**
- Jerky, inaccurate saccades with head movement
- Reduced vergence facility (unable to clear BO)
- Poor accommodative flexibility, especially with plus
- Visual fatigue worsening through the school day

(Consistent with eye movement dysfunction patterns described in)

2. **Binocular Stress / CI**
- Reduced BO ranges
- Diplopia at near under reduced illumination
- Near-point stress despite normal NPC

(Consistent with concussion-related CI mechanisms in)

3. **Autonomic / Sensory Overload**
- Light sensitivity (fluorescent & outdoor)
- Motion sensitivity
- Symptom escalation with cognitive-visual load
- Worse later in day → parasympathetic fatigue

(Consistent with autonomic dysregulation in)

4. **Functional Impact**
- Chromebook intolerance
- Reduced reading stamina
- Eye pain, headaches, visual fatigue
- Predictive symptom score >31 (high rehab responder likelihood)

PERSONALIZED TREATMENT PROTOCOL
Format: Office-based vision-centered neuro-rehabilitation
Frequency: 1-2× / week, 45-60 min
Estimated Duration: 12-16 weeks

PHASE 1: STABILIZATION & AUTONOMIC CALMING (Weeks 1-4)
Goals
- Reduce symptom volatility
- Improve visual comfort
- Establish parasympathetic dominance
- Prepare system for motor learning

Therapy Emphasis
- Large-field, low-frequency visual tasks
- Reduced demand, high success
- Controlled lighting environments

Procedures
- **Binocular anti-suppression at distance**
- **Gross vergence awareness without demand**
- **Monocular accommodative release**
- **Saccadic awareness without speed**
- **Visual-vestibular dissociation (yaw-limited)**

Home Support
- Light-filtered lenses as needed
- Scheduled visual breaks during Chromebook use
- Avoid end-range vergence stress early

(Phase structure consistent with concussion foundations framework)

PHASE 2: OCULOMOTOR & BINOCULAR INTEGRATION (Weeks 5-10)

Goals
- Normalize saccadic accuracy
- Improve BO facility
- Restore accommodative flexibility
- Increase visual stamina

Therapy Emphasis
- Precision before speed
- Binocular motor planning
- Reduced head substitution

Procedures
- Horizontal and vertical saccadic sequencing
- Vergence facility with graded BO demand
- Accommodative rock with controlled plus
- Near-to-far integration tasks
- Visual endurance drills with cognitive overlay

(Eye movement remediation principles from)

PHASE 3: FUNCTIONAL LOAD & SCHOOL SIMULATION (Weeks 11-16)

Goals
- Chromebook tolerance
- Sustained reading without symptom escalation
- Classroom visual resilience
- Return to full academic visual load

Therapy Emphasis
- Time-based endurance
- Multisensory integration
- Stress inoculation

Procedures
- Timed reading and tracking
- Complex saccade-vergence tasks
- Visual-cognitive dual tasking
- Lighting variability exposure
- Motion + visual integration drills

(Functional reintegration supported by)

PREDICTED PATIENT OUTCOME

Prognosis: GOOD → VERY GOOD

Positive Predictors
- Young age (high neuroplasticity)
- No prior concussion history
- Normal ocular health
- High symptom-test mismatch (responders)
- DEM speed intact (motor learning intact)
- NPC intact → good convergence potential

Expected Improvements

Domain	Expected Change
Reading stamina	↑ significantly
Chromebook tolerance	↑ to full school day
Eye pain/headaches	↓ markedly
Light sensitivity	↓ moderate to significant
Saccadic accuracy	Normalize
BO facility	Improve to functional levels
End-of-day fatigue	↓ substantially

Timeline
- **4-6 weeks:** noticeable symptom relief
- **8-10 weeks:** academic tolerance improves
- **12-16 weeks:** functional normalization for school

Residual Risk
- Temporary symptom flare with rapid academic load increases
- Requires coordination with school accommodations during rehab

SUMMARY

This patient demonstrates a **textbook post-concussion visual efficiency collapse,** not structural ocular pathology. Vision-centered neurorehabilitation is **indicated, necessary, and likely highly effective,** with expected return to age-appropriate visual performance when therapy is sequenced correctly.

If you want, I can:

- Convert this into a formal clinic-ready treatment plan
- Generate parent-friendly counseling language
- Create school accommodation recommendations
- Compare this case against poor-responder patterns

CASE 2: 26-Year-Old Male — Work-Related Concussion

Dx:

- Concussion without loss of consciousness
- Convergence insufficiency
- Accommodative spasm (bilateral)
- Deficient saccadic eye movements

(Clinical data derived from ABI/VT evaluation)

CLINICAL PATTERN RECOGNITION

Primary Dysfunction Clusters

This patient demonstrates a **moderate-severe post-concussion visual-vestibular integration failure** with binocular instability and autonomic overload.

1. Binocular Instability / CI Pattern

- Near exophoria with OS drifting in (confirmed by Occupational Therapy (OT))
- NPC significantly receded (18 cm break / 24 cm recovery)
- Vergence facility **0 CPM**, unable to clear BO
- Diplopia emerging in real-world environments (stadium, stores)
- Reduced stereoacuity (70 arc sec)

→ Indicates **poor fusional endurance,** not baseline strabismus.

2. Oculomotor Control Deficit

- Saccadic inaccuracy with head substitution
- Reduced DEM speed (FAIL/FAIL)
- Visual tracking breakdown under load
- Difficulty maintaining fixation in visually busy environments

(Consistent with concussion-related oculomotor inefficiency patterns described in the Eye Movements reference)

3. Autonomic/Sensory Overload

- Disorientation in loud environments
- Balance failure on Adult Developmental Eye Movement (ADEM)
- Difficulty in stores (classic visual motion sensitivity)
- Head pain escalation with sensory input

→ Suggests visual-vestibular mismatch and sympathetic dominance.

(Aligned with autonomic dysfunction patterns in)

4. Functional Impact

- Daily headaches
- Diplopia in public environments
- Work intolerance
- Reliance on OT/Physical Therapy (PT) without visual system normalization

PERSONALIZED TREATMENT PROTOCOL

Format: Vision-centered neuro-optometric rehabilitation (office-based)
Frequency: 1-2× / week, 45-60 minutes
Estimated Duration: 16-20 weeks (severity-adjusted)

PHASE 1: STABILIZATION & BINOCULAR CALMING (Weeks 1-4)

Goals

- Reduce diplopia frequency
- Establish binocular awareness without demand
- Calm autonomic overactivation
- Reduce head movement compensation

Therapy Emphasis
- Low-load, high-success binocular tasks
- Controlled sensory environment
- Avoidance of end-range vergence stress

Procedures
- **Large-field fusion awareness**
- **Monocular accommodative release**
- **Anti-suppression with distance emphasis**
- **Slow, predictable saccadic initiation**
- **Visual-vestibular dissociation (yaw-limited)**

(Home support coordinated with OT to prevent overloading)
(Foundational sequencing supported by)

PHASE 2: BINOCULAR & OCULOMOTOR INTEGRATION (Weeks 5-12)
Goals
- Restore BO vergence control
- Improve fusional stamina
- Normalize saccadic accuracy
- Reduce diplopia under motion

Therapy Emphasis
- Precision before speed
- Binocular motor planning
- Gradual sensory complexity

Procedures
- **Stepwise BO vergence training**
- **Vergence facility with extended recovery time**
- **Horizontal & vertical saccadic sequencing**
- **Fixation stability under motion**
- **Near-far integration drills**

(Protocols aligned with concussion rehab framework)

PHASE 3: FUNCTIONAL LOAD & WORK SIMULATION (Weeks 13-20)
Goals
- Tolerance of visually complex environments
- Eliminate real-world diplopia
- Restore balance confidence
- Return to work without symptom escalation

Therapy Emphasis
- Time-based endurance
- Multisensory integration
- Stress inoculation

Procedures
- **Store-aisle simulation tasks**
- **Visual motion desensitization**
- **Dual-task visual-vestibular drills**
- **Noise + visual integration**
- **Work-specific visual demands**

PREDICTED PATIENT OUTCOME
Prognosis: FAIR → GOOD

Positive Predictors
- No prior concussion history
- Intact ocular health
- Actively engaged in multidisciplinary rehab
- Strong accommodative amplitude baseline

Limiting Factors
- Significant vestibular involvement
- Balance failure on ADEM
- Diplopia emerging under real-world load
- Autonomic instability

Expected Improvements

Domain	Expected Change
Diplopia	↓ significant
Store tolerance	↑ moderate to high
Headaches	↓ frequency & intensity
Balance confidence	↑
Vergence facility	Improve from 0 CPM to functional
Work endurance	Gradual restoration

Timeline
- **4-6 weeks:** reduced diplopia frequency
- **8-12 weeks:** improved store/work tolerance
- **16-20 weeks:** functional binocular stability

SUMMARY

This patient exhibits a **true binocular-vestibular concussion profile,** not a refractive or structural issue. Vision-centered neuro-rehabilitation is **essential** for resolution, as OT/PT alone cannot normalize binocular control. With appropriately sequenced therapy, return to functional work performance is expected.

When you're ready, say **"next case"**, and I'll proceed with the following patient in the **same exact format**.

CASE 3: 27-Year-Old Female — Motor Vehicle Accident with Prior Concussion

Dx:

- Concussion without loss of consciousness
- Convergence insufficiency
- Deficient saccadic eye movements
- Congenital retinal finding (CHRPE OS — incidental, monitored)

(Clinical data derived from ABI/VT evaluation)

CLINICAL PATTERN RECOGNITION

Primary Dysfunction Clusters

This patient demonstrates a **recurrent concussion visual efficiency collapse** with preserved basic oculomotor mechanics but **poor endurance, speed, and sensory tolerance** under load.

1. Binocular Stress / CI with Endurance Failure

- Near exophoria with reduced BI facility (fails BI)
- BO ranges adequate in isolation but degrade with sustained demand
- NPC to nose intact → **capacity present, stamina deficient**
- Alternating suppression on Worth 4 Dot (distance/near)

→Indicates **binocular instability under fatigue,** not fixed alignment loss.

2. Oculomotor Endurance & Speed Deficit

- NSUCO largely passing except **saccadic body control**
- Developmental Eye Movement (DEM): **Speed FAIL** despite otherwise organized eye movements
- Patient-reported difficulty with reading, screen time, and fatigue

→ Classic **post-concussion oculomotor inefficiency,** not primary eye movement paresis.

(Consistent with concussion eye-movement fatigue patterns in)

3. Autonomic/Sensory Overload

- Visual distortions under fluorescent lighting ("squiggly lines")
- End-of-day headaches (4/7 days)
- Sensory fatigue in busy environments
- Balance complaints (stairs), though ADEM balance passes

→ Reflects **sensory integration overload** rather than vestibular failure.

(Aligned with autonomic dysregulation described in)

4. Functional Impact

- Screen intolerance
- Reduced reading stamina
- Visual fatigue limiting OT progression
- History of **multiple concussions → lower reserve**

PERSONALIZED TREATMENT PROTOCOL

Format: Vision-centered neuro-optometric rehabilitation (office-based)

Frequency: 1× / week initially → progress to 2×/week as tolerated

Estimated Duration: 12-16 weeks

PHASE 1: VISUAL EFFICIENCY STABILIZATION (Weeks 1-4)

Goals

- Reduce visual fatigue
- Improve binocular comfort
- Normalize autonomic tone
- Prevent over-fatigue during therapy

Therapy Emphasis

- Endurance-based tasks at sub-symptom threshold
- Controlled lighting
- High success, low variability

Procedures

- Sustained fixation with controlled breaks
- Low-demand binocular fusion tasks
- Monocular accommodative flexibility
- Slow saccadic initiation without speed demand
- Visual calming techniques

(Sequencing consistent with concussion foundations framework)

PHASE 2: BINOCULAR & OCULOMOTOR ENDURANCE (Weeks 5-10)

Goals

- Improve BI facility
- Increase reading and screen stamina
- Normalize saccadic speed without body substitution

Therapy Emphasis

- Time-on-task pr ogression
- Precision before speed
- Gradual sensory complexity

Procedures

- BI vergence stamina training
- Vergence facility with fatigue monitoring
- Saccadic sequencing with postural control
- Near-far integration
- Cognitive-visual dual tasks

(Protocols supported by concussion treatment framework)

PHASE 3: FUNCTIONAL INTEGRATION & RETURN TO LOAD (Weeks 11-16)

Goals

- Restore screen tolerance
- Reduce end-of-day headaches
- Improve performance in visually busy environments
- Support full participation in OT and daily activities

Therapy Emphasis

- Endurance under realistic conditions
- Sensory stress inoculation
- Task-specific carryover

Procedures

- **Extended reading and screen simulations**
- **Fluorescent lighting exposure drills**
- **Dual-task visual-cognitive activities**
- **Stair-navigation visual tasks**
- **Fatigue recovery training**

PREDICTED PATIENT OUTCOME

Prognosis: GOOD

Positive Predictors

- Young age
- Intact basic oculomotor mechanics
- NPC intact
- Good stereoacuity
- Actively engaged in multidisciplinary care

Limiting Factors

- History of prior concussion
- Sensory overload susceptibility
- Endurance-based symptom provocation

Expected Improvements

Domain	Expected Change
Screen tolerance	↑ significant
Reading stamina	↑
End-of-day headaches	↓ frequency
Visual fatigue	↓
Saccadic speed	Normalize
Sensory tolerance	↑ moderate

Timeline

- **3-5 weeks:** noticeable reduction in visual fatigue
- **8-10 weeks:** improved screen and reading tolerance
- **12-16 weeks:** functional normalization for daily activities

SUMMARY

This patient represents a high-capacity, low-endurance post-concussion profile compounded by repeat injury. Vision-centered neuro-rehabilitation is strongly indicated and is expected to significantly reduce fatigue-based symptoms, enabling more effective participation in OT and daily life.

Say **"next case"** when ready, and I'll continue with the following patient in the **same exact format.**

CASE 4: 55-Year-Old Female — Assault-Related Concussion with Severe Visual Disruption

Dx:

- Concussion with loss of consciousness (<30 minutes)
- Convergence insufficiency
- Deficient saccadic eye movements
- Deficient smooth pursuit eye movements
- Suspected visual field disruption (pending automated fields)

(Clinical data derived from ABI/VT evaluation)

CLINICAL PATTERN RECOGNITION

Primary Dysfunction Clusters

This patient presents with a **severe, multi-system post-concussion visual breakdown** characterized by binocular collapse, oculomotor instability, sensory overload, and balance failure.

1. Severe Binocular Dysfunction/Diplopia Dominant Profile

- Markedly receded NPC (blur 42 cm; break 35 cm)
- Extremely reduced vergence ranges and vergence facility 0 CPM (fails BI & BO)
- Constant diplopia, worse at near; frequent eye closure for clarity
- Poor stereoacuity (200 arc sec; 2/10 Randot)
- Indicates loss of fusional control, not simple CI.

2. Global Oculomotor Instability

- Jerky pursuits and saccades with undershoots
- NSUCO scores reduced across ability, accuracy, and head control
- DEM: Speed FAIL / Balance FAIL
- Difficulty maintaining fixation and tracking

→ Reflects diffuse oculomotor network disruption, consistent with moderate TBI visual sequelae.

(*Consistent with eye-movement pathology described in*)

3. Autonomic & Sensory Overload

- Severe light sensitivity (fluorescent and outdoor)
- Visual motion intolerance; avoidance of busy environments
- Balance failure on ADEM
- Headaches provoked by visual use

→ Suggests significant autonomic dysregulation with visual-vestibular mismatch.

(Aligned with autonomic mechanisms outlined in)

4. Functional Impact

- Constant diplopia
- Reading nearly impossible
- Severe depth perception disturbance
- Loss of confidence walking and navigating space
- High symptom burden (BIVSS 93/112; strong rehab responder)

PERSONALIZED TREATMENT PROTOCOL

Format: Vision-centered neuro-optometric rehabilitation (office-based)
Frequency: 2× / week (severity-driven)
Estimated Duration: 20-24 weeks

PHASE 1: NEUROVISUAL STABILIZATION & SAFETY (Weeks 1-6)

Goals

- Reduce diplopia intensity
- Improve visual comfort and safety
- Establish basic binocular awareness
- Decrease autonomic overactivation

Therapy Emphasis

- Very low demand
- Large-field stimuli
- High success, short duration tasks

Procedures

- **Monocular control with gradual binocular introduction**
- **Large, slow pursuit awareness**
- **Anti-suppression without vergence demand**
- **Visual midline and spatial orientation tasks**
- **Environmental light control strategies**

(Foundational sequencing per concussion rehab principles)

PHASE 2: BINOCULAR RE-ESTABLISHMENT & OCULOMOTOR CONTROL (Weeks 7-16)

Goals

- Rebuild fusional reserves
- Improve pursuit and saccadic accuracy
- Increase tolerance to near tasks
- Reduce reliance on eye closure

Therapy Emphasis

- Precision before endurance
- One parameter at a time
- Strict symptom threshold monitoring

Procedures

- Stepwise vergence re-training (short ranges)
- Vergence facility with extended recovery
- Guided pursuit tracking
- Saccadic accuracy drills without speed
- Near-far integration in controlled posture

(Protocols consistent with concussion treatment framework)

PHASE 3: FUNCTIONAL INTEGRATION & MOBILITY CONFIDENCE (Weeks 17-24)

Goals

- Improve depth perception
- Reduce diplopia in real-world settings
- Restore walking and navigation confidence
- Improve reading tolerance

Therapy Emphasis

- Functional carryover
- Visual-vestibular reintegration
- Gradual sensory complexity

Procedures

- **Depth judgment tasks**
- **Mobility-based visual drills**
- **Dual-task balance + vision activities**
- **Graduated exposure to busy environments**
- **Extended reading with pacing strategies**

PREDICTED PATIENT OUTCOME

Prognosis: GUARDED → FAIR

Positive Predictors

- No prior concussion history
- Strong motivation and compliance
- Clear symptom-test correlation (high responder score)

Limiting Factors

- Age
- LOC with assault mechanism
- Severe baseline diplopia
- Balance failure and sensory overload

Expected Improvements

Domain	Expected Change
Diplopia	↓ meaningful but may persist intermittently
Reading tolerance	↑ from minimal to functional
Light sensitivity	↓ moderate
Depth perception	↑
Balance confidence	↑
Overall visual comfort	↑

Timeline

- **6-8 weeks:** reduced visual distress, safer mobility
- **12-16 weeks:** improved near task tolerance
- **20-24 weeks:** functional gains with possible residual symptoms

SUMMARY

This patient represents a **severe post-concussion visual integration failure** involving binocular vision, oculomotor control, and autonomic regulation. Vision-centered neuro-rehabilitation is medically necessary, safety-oriented early, and expected to yield meaningful functional improvement, though some residual symptoms may remain.

Say **"next case"** when ready, and I'll proceed with the following patient in the **same exact format.**

CASE 5: 48-Year-Old Female — Motor Vehicle Accident with Visual Fatigue & Reading Dysfunction

Dx:

- Concussion without loss of consciousness
- Convergence insufficiency
- Deficient saccadic eye movements

(Clinical data derived from ABI/VT evaluation)

CLINICAL PATTERN RECOGNITION

Primary Dysfunction Clusters

This patient demonstrates a **moderate post-concussion visual efficiency and endurance collapse** with preserved alignment and eye movement mechanics, but **poor tolerance to sustained visual and cognitive load,** particularly with screens and reading.

1. Binocular Stress/CI with Fatigue Component

- Near vergence breakdown with failure to clear BO on vergence facility
- NPC blur at 24 cm despite ability to converge to nose
- Stereoacuity intact (20 arc sec) → **binocular potential preserved**
- Worth 4 Dot stable → no constant suppression or diplopia

→ Indicates **binocular stamina failure**, not structural binocular loss.

2. Oculomotor Endurance & Speed Deficit

- Pursuits and saccades smooth on qualitative testing
- NSUCO scores all passing
- DEM: **Speed FAIL** despite normal balance

→ Reflects **reduced processing speed and visual sequencing efficiency,** common in concussion without focal eye movement paresis.

(Consistent with post-concussion eye movement inefficiency described in)

3. Autonomic/Sensory Load Sensitivity

- Eye strain and headaches provoked by screen use
- Sound sensitivity and visually busy environment intolerance
- Driving anxiety (better as passenger)
- End-of-day fatigue pattern

→ Suggests **visual-autonomic overload,** rather than vestibular failure (ADEM balance PASS).

(Aligned with autonomic dysregulation patterns in)

4. Functional Impact

- Reading difficulty and slow comprehension
- Screen intolerance
- Reduced confidence in driving
- Visual fatigue limiting daily activities

PERSONALIZED TREATMENT PROTOCOL

Format: Vision-centered neuro-optometric rehabilitation (office-based)

Frequency: 1× / week (progress to 2× / week if tolerated)

Estimated Duration: 12-14 weeks

PHASE 1: VISUAL COMFORT & STABILITY (Weeks 1-4)

Goals
- Reduce visual strain and headaches
- Improve comfort with near work
- Normalize autonomic tone during visual tasks

Therapy Emphasis
- Low variability
- Controlled lighting
- Short-duration, high-success tasks

Procedures
- **Sustained fixation with pacing**
- **Low-demand binocular fusion tasks**
- **Monocular accommodative balance**
- **Slow saccadic initiation**
- **Visual rest-recovery training**

(Sequencing aligned with concussion foundations framework)

PHASE 2: BINOCULAR & OCULOMOTOR ENDURANCE (Weeks 5-9)

Goals
- Improve BO vergence stamina
- Increase reading endurance
- Normalize visual processing speed

Therapy Emphasis
- Time-on-task progression
- Precision before speed
- Symptom-threshold monitoring

Procedures
- **BO vergence stamina training**
- **Vergence facility with extended recovery**
- **Saccadic sequencing drills**
- **Near-far integration**
- **Reading efficiency tasks**

(Protocols consistent with concussion rehab strategies)

PHASE 3: FUNCTIONAL INTEGRATION & DRIVING CONFIDENCE (Weeks 10-14)

Goals
- Restore screen tolerance
- Improve reading speed and comprehension
- Reduce visual fatigue during driving and busy environments

Therapy Emphasis
- Real-world simulation
- Cognitive-visual integration
- Endurance under realistic conditions

Procedures
- **Extended screen simulation**
- **Dual-task visual-cognitive drills**
- **Visual scanning for driving**
- **Environmental complexity exposure**
- **Fatigue recovery strategies**

PREDICTED PATIENT OUTCOME

Prognosis: GOOD

Positive Predictors
- No LOC
- No prior concussions
- Intact stereoacuity and eye movements
- ADEM balance intact
- Moderate symptom profile (predictive score >31)

Limiting Factors
- High daily screen exposure
- Sensory sensitivity

Expected Improvements

Domain	Expected Change
Reading stamina	↑ significant
Screen tolerance	↑
Headaches	↓ frequency
Eye strain	↓
Visual processing speed	Normalize
Driving confidence	↑

Timeline

- **3-4 weeks:** reduced eye strain and headaches
- **6-8 weeks:** improved reading and screen tolerance
- **12-14 weeks:** return to normal daily visual demands

SUMMARY

This patient represents a visual endurance-dominant concussion profile with preserved mechanics but impaired stamina and processing speed. Vision-centered neuro-rehabilitation is expected to be highly effective, with strong likelihood of full functional recovery.

Say **"next case"** when ready, and I'll continue with the following patient in the **same exact format.**

CASE 6: 49-Year-Old Female — Motor Vehicle Accident with Headache-Dominant Visual Instability

Dx:

- Concussion with brief loss of consciousness (<1 minute)
- Convergence insufficiency
- Deficient saccadic eye movements

(Clinical data derived from ABI/VT evaluation)

CLINICAL PATTERN RECOGNITION

Primary Dysfunction Clusters

This patient presents with a **headache- and dis-orientation-dominant post-concussion visual profile,** where binocular instability and visual overload are major drivers of symptoms rather than gross oculomotor paresis.

1. **Binocular Instability with Headache Provocation**
   - Esophoric tendency on OD in vertical positions at near
   - Reduced BO ranges with **vergence facility 0 CPM (fails BO)**
   - NPC blur at 33 cm despite ability to converge to nose
   - Closing the **right eye reduces headache and disorientation**

   → Indicates **binocular stress-driven headache,** not primary ocular disease.

2. **Oculomotor Mechanics Intact, Efficiency Reduced**
   - Qualitative pursuits and saccades smooth
   - NSUCO scores passing across domains
   - DEM: **Speed FAIL** with preserved balance

   → Suggests **processing-speed and endurance inefficiency,** common after concussion with brief LOC.

(Consistent with concussion-related eye-movement inefficiency described in)

3. **Autonomic/Sensory Overload**
   - Headaches all day (1-7/10), worsened by screens
   - Disorientation with visual strain
   - Photo-sensitivity intermittent
   - Postural instability when both eyes closed

   → Reflects visual-autonomic imbalance and poor visual contribution to postural control.

(Aligned with autonomic dysregulation mechanisms in)

4. **Functional Impact**
   - Inability to tolerate dual screens or multiple tabs
   - Reading intolerance
   - Screen time precipitates headache and dizziness
   - Reliance on eye closure to manage symptoms

PERSONALIZED TREATMENT PROTOCOL

Format: Vision-centered neuro-optometric rehabilitation (office-based)
Frequency: 1-2× / week (symptom-driven)
Estimated Duration: 14-18 weeks

PHASE 1: HEADACHE REDUCTION & BINOCULAR CALMING (Weeks 1-5)

Goals
- Reduce headache frequency and intensity
- Improve binocular comfort
- Decrease visual-driven disorientation
- Establish stable visual input for posture

Therapy Emphasis
- Low-load binocular work
- Controlled lighting
- Strict symptom-threshold pacing

Procedures
- **Monocular-binocular balance tasks**
- **Large-field fusion awareness**
- **Accommodative release techniques**
- **Slow, predictable saccadic initiation**
- **Visual midline and posture stabilization tasks**

(Foundational sequencing supported by)

PHASE 2: BINOCULAR STAMINA & OCULOMOTOR EFFICIENCY (Weeks 6-12)

Goals
- Improve BO vergence endurance
- Reduce reliance on eye closure
- Normalize visual processing speed
- Improve tolerance to reading and screens

Therapy Emphasis
- Precision before endurance
- Gradual load increases
- Recovery-based pacing

Procedures
- **Stepwise BO vergence training**
- **Vergence facility with extended recovery**
- **Saccadic sequencing with postural control**
- **Near-far integration drills**
- **Reading efficiency training**

(Protocols consistent with concussion rehabilitation framework)

PHASE 3: FUNCTIONAL LOAD & SCREEN REINTEGRATION (Weeks 13-18)

Goals
- Tolerate sustained screen use
- Reduce headache provocation from visual tasks
- Restore confidence with multitasking
- Improve daily functional endurance

Therapy Emphasis
- Real-world simulation
- Cognitive-visual dual tasking
- Endurance under realistic conditions

Procedures
- **Single- to dual-screen simulation**
- **Multi-tab visual scanning tasks**
- **Extended reading with pacing**
- **Visual-cognitive multitasking**
- **Fatigue recovery strategies**

PREDICTED PATIENT OUTCOME
Prognosis: GOOD

Positive Predictors
- Brief LOC only
- No prior concussion history
- Intact oculomotor mechanics
- Good engagement in multidisciplinary care

Limiting Factors
- Daily headache burden
- Visual-driven disorientation
- Autonomic sensitivity

Expected Improvements

Domain	Expected Change
Headache frequency/intensity	↓ significant
Screen tolerance	↑
Reading stamina	↑
Visual-induced dizziness	↓
Vergence stamina	Normalize
Daily functional endurance	↑

Timeline

- **4-6 weeks**: reduction in headache severity
- **8-12 weeks:** improved reading and screen tolerance
- **14-18 weeks:** functional return to daily visual demands

SUMMARY

This patient exhibits a **binocular stress-driven, headache-dominant concussion profile.** Vision-centered neuro-rehabilitation is strongly indicated and expected to significantly reduce headaches and visual-provoked disorientation, enabling return to normal screen and reading activities.

Say **"next case"** when ready, and I'll proceed with the following patient in the **same exact format.**

CASE 7: 49-Year-Old Female — Motor Vehicle Accident with Photophobia & Visual Fatigue

Dx:

- Concussion without loss of consciousness
- Convergence insufficiency
- Deficient saccadic eye movements
- Deficient smooth pursuit eye movements

(Clinical data derived from ABI/VT evaluation)

CLINICAL PATTERN RECOGNITION

Primary Dysfunction Clusters

This patient demonstrates a **light-sensitivity-dominant post-concussion visual profile** with binocular inefficiency, oculomotor fatigue, and autonomic visual overload, compounded by **high visual demand occupational exposure** (teaching).

1. Photophobia & Autonomic Visual Overload

- Severe light sensitivity: indoor glare, fluorescent lights, outdoor light **always problematic**
- Requires environmental light reduction at work
- Visual discomfort worsens as day progresses
- Blur OD >> OS later in the day

→ Indicates **parasympathetic fatigue with sympathetic overdrive,** common in concussion-related autonomic visual dysfunction.

(Consistent with autonomic mechanisms outlined in)

2. Binocular Inefficiency with Endurance Failure

- Vergence ranges reduced, especially BO (break 8)
- Vergence facility **0 CPM,** unable to clear BO
- NPC receded (18/23 cm)
- Worth 4 Dot: suppression at near in dark (5 dots)

→ Suggests **binocular instability under fatigue,** not constant diplopia.

3. Oculomotor Fatigue

- Jerky saccades with undershoots
- Reduced head control on NSUCO
- DEM: balance FAIL, speed PASS
- Smooth pursuits affected under sustained demand

→ Reflects **fatigue-driven oculomotor breakdown,** rather than structural eye movement disorder.

(Aligned with post-concussion eye movement inefficiency in)

4. Functional Impact

- Teaching environment intolerable without light modification
- End-of-day blur and squinting
- Headaches still occurring weekly
- Difficulty sustaining visually demanding workdays

PERSONALIZED TREATMENT PROTOCOL

Format: Vision-centered neuro-optometric rehabilitation (office-based)
Frequency: 1-2× / week
Estimated Duration: 14-18 weeks

PHASE 1: PHOTOPHOBIA REDUCTION & VISUAL COMFORT (Weeks 1-4)

Goals

- Reduce light sensitivity
- Improve visual comfort during workday
- Stabilize autonomic visual responses
- Reduce end-of-day blur

Therapy Emphasis

- Low illumination environments initially
- Large-field, low-frequency visual input
- High success, short duration tasks

Procedures

- Visual adaptation under controlled lighting
- Monocular accommodative release
- Low-demand binocular fusion
- Large-field pursuit awareness
- Environmental modification counseling

(Sequencing consistent with concussion foundations framework)

PHASE 2: BINOCULAR & OCULOMOTOR ENDURANCE (Weeks 5-10)

Goals

- Improve BO vergence stamina
- Reduce visual fatigue progression through day
- Normalize saccadic accuracy under load

Therapy Emphasis

- Precision before endurance
- Gradual increase in light exposure
- Fatigue monitoring

Procedures

- **Stepwise BO vergence training**
- **Vergence facility with extended recovery**
- **Saccadic sequencing drills**
- **Near-far integration**
- **Controlled light variability exposure**

(Protocols aligned with concussion rehab strategies)

PHASE 3: FUNCTIONAL WORKPLACE INTEGRATION (Weeks 11-18)

Goals

- Tolerate full classroom lighting
- Sustain teaching day without symptom escalation
- Reduce reliance on light avoidance strategies

Therapy Emphasis

- Endurance under realistic conditions
- Cognitive-visual integration
- Sensory stress inoculation

Procedures

- **Extended visual endurance tasks**
- **Fluorescent lighting simulation**
- **Dual-task visual-cognitive drills**
- **Reading and board-to-paper transitions**
- **Fatigue recovery strategies**

PREDICTED PATIENT OUTCOME

Prognosis: GOOD

Positive Predictors

- No LOC
- Only one prior concussion (remote)
- Intact ocular health
- Clear symptom-test correlation (predictive score >31)
- High motivation due to occupational demands

Limiting Factors

- High daily visual load
- Significant photophobia baseline

Expected Improvements

Domain	Expected Change
Light sensitivity	↓ significant
End-of-day blur	↓
Visual fatigue	↓
Classroom tolerance	↑
Vergence stamina	Normalize
Headache frequency	↓

Timeline
- **3-5 weeks:** improved light tolerance and comfort
- **8-10 weeks:** reduced end-of-day blur and fatigue
- **14-18 weeks:** full functional workday tolerance

SUMMARY
This patient exhibits a **photophobia-dominant concussion visual profile** driven by autonomic dysregulation and binocular fatigue. Vision-centered neuro-rehabilitation is strongly indicated and expected to restore classroom tolerance and visual endurance with appropriate sequencing and light exposure control.

Say **"next case"** when ready, and I'll proceed with the **final remaining case** in the **same exact format.**

CASE 8: 62-Year-Old Female — Post-Strabismus Surgery with Binocular Coordination Deficit
Dx:
- Convergence insufficiency
- Deficient saccadic eye movements
- Other lack of coordination (post-surgical binocular instability)

(Clinical data derived from ABI/VT evaluation)

CLINICAL PATTERN RECOGNITION
Primary Dysfunction Clusters
This patient presents with a **post-surgical binocular coordination failure,** not an active neurologic concussion pattern. Symptoms are driven by **loss of adaptive binocular control** following strabismus surgery rather than structural recurrence of the deviation.

1. Post-Strabismus Binocular Instability
- History of strabismus surgery (~2023)
- Residual esophoric tendency OS (3Δ vertical noted)
- Vergence ranges reduced (BI 6 / BO 8)
- Vergence facility slowed (3 CPM, slow BO)
- Worth 4 Dot alternating at distance → unstable fusion

→ Indicates poor post-surgical sensory-motor recalibration, not surgical failure.

2. Oculomotor Mechanics Preserved
- Pursuits and saccades smooth
- NSUCO scores all passing
- DEM: balance FAIL, speed PASS
- Stereoacuity reduced but present (50 arc sec)

→ Suggests coordination inefficiency, not cranial nerve palsy or active neurologic disease.

(Consistent with eye movement efficiency concepts in)

3. Sensory Integration & Spatial Awareness Issues
- Overlapping/shadowed peripheral vision
- Visual strain without constant diplopia
- Difficulty maintaining stable single vision under fatigue
- No suppression, but alternating fusion instability

→ Reflects central fusion instability common after late-life strabismus surgery without rehabilitation.

4. Functional Impact
- Visual strain during daily tasks
- Peripheral visual confusion
- Reduced confidence in sustained binocular use
- Concern regarding long-term visual stability

PERSONALIZED TREATMENT PROTOCOL
Format: Vision-centered neuro-optometric rehabilitation (office-based)
Frequency: 1× / week
Estimated Duration: 10-14 weeks

PHASE 1: BINOCULAR AWARENESS & STABILITY (Weeks 1-4)
Goals
- Improve binocular sensory awareness
- Reduce visual strain
- Establish stable fusion at comfortable ranges
- Prevent regression into suppression or diplopia

Therapy Emphasis
- Low demand, high success
- Sensory fusion before motor demand
- Short, repeatable tasks

Procedures
- **Binocular awareness and alignment feedback**
- **Large-field fusion tasks**
- **Monocular-binocular balance activities**
- **Slow, predictable saccadic initiation**
- **Peripheral awareness integration**

(Foundational sequencing consistent with rehabilitation principles)

PHASE 2: BINOCULAR COORDINATION & ENDURANCE (Weeks 5-9)

Goals
- Improve vergence stamina
- Normalize BO facility
- Reduce peripheral overlap sensations
- Increase confidence in sustained binocular use

Therapy Emphasis
- Precision before endurance
- Gradual increase in fusional demand
- Fatigue monitoring

Procedures
- **Stepwise vergence training**
- **Vergence facility pacing**
- **Near-far integration**
- **Saccadic sequencing with fusion maintenance**
- **Spatial localization tasks**

(Protocols aligned with binocular rehabilitation strategies)

PHASE 3: FUNCTIONAL BINOCULAR INTEGRATION (Weeks 10-14)

Goals
- Stabilize binocular vision in daily environments
- Eliminate shadowing/overlap sensations
- Restore confidence in visual coordination

Therapy Emphasis
- Functional carryover
- Real-world visual tasks
- Endurance under daily conditions

Procedures
- **Extended fusion tasks**
- **Peripheral-central integration drills**
- **Dual-task visual coordination**
- **Visual endurance exercises**
- **Home carryover strategies**

PREDICTED PATIENT OUTCOME

Prognosis: GOOD

Positive Predictors
- Stable ocular health
- Successful prior surgical alignment
- Preserved oculomotor mechanics
- Motivation to improve coordination

Limiting Factors
- Age-related neuroplasticity limits
- Long interval post-surgery without rehab
- History of long-standing binocular disorder

Expected Improvements

Domain	Expected Change
Visual strain	↓ significant
Fusion stability	↑
Peripheral overlap	↓
Vergence facility	Normalize
Daily visual confidence	↑

Timeline
- **3-4 weeks:** reduced strain, improved comfort
- **6-9 weeks:** improved fusion endurance
- **10-14 weeks:** stable binocular function for daily tasks

SUMMARY

This patient exhibits a **post-strabismus sensory-motor coordination deficit,** not recurrent strabismus or neurologic pathology. Vision-centered neuro-rehabilitation is **highly appropriate and expected to be effective,** restoring binocular stability, reducing strain, and improving long-term surgical outcomes.

All uploaded cases are now complete using the **exact same format.**

If you want, next I can:

- Convert these into **formal chart-ready treatment plans**
- Create **outcome-prediction language for reports**
- Build a **teaching library of concussion vs non-concussion visual patterns**
- Compare responder vs non-responder phenotypes across cases

ADDENDUM B

Self-Determination of IRB Exemption

Study Title: The Future of AI in Clinical Decision Support for the Neuro-Optometrist

Principal Investigator:
Chad Edmonds, OD
Edmonds Eye Associates
Philadelphia, PA

Statement of Ethical Review and IRB Exemption
This study involved a retrospective analysis of existing clinical records for the purpose of comparing clinician-prescribed neuro-optometric vision therapy protocols with treatment recommendations generated by an artificial intelligence (AI) model.

All patient data used in this study were fully de-identified prior to analysis, in accordance with the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule Safe Harbor method (45 CFR §164.514). No protected health information (PHI), direct identifiers, or indirect identifiers were included at any stage of data processing or analysis.

The study did not involve prospective data collection, patient recruitment or contact, intervention or alteration of clinical care, or the use of identifiable private information.

Because the dataset consisted solely of existing, de-identified data, this research does not constitute human subjects research as defined under 45 CFR §46.102 and qualifies for IRB exemption under 45 CFR §46.104(d)(4) (secondary research involving de-identified information).

Based on these criteria, a formal Institutional Review Board (IRB) review was not required. This exemption determination was made by the principal investigator in accordance with U.S. federal research ethics regulations and standard publication guidelines.

All analyses involving artificial intelligence were conducted using ChatGPT Pro, with only fully de-identified data entered into the system. No identifiable patient information was transmitted, stored, or processed within the AI platform.

Certification
I certify that this study was conducted in compliance with applicable ethical standards and regulatory requirements for exempt research, and that all reasonable measures were taken to protect patient privacy and confidentiality.

Signed: Chad T. Edmonds, OD (e-signature -4/28/2026- 9:14PM)
Chad Edmonds, OD
Principal Investigator
Edmonds Eye Associates
Philadelphia, PA
Date: 04/28/2026