

## Visual-Vestibular Rehabilitation Using Orthoptic and Vestibulo-Ocular Reflex Training in Parinaud Syndrome: A Case Report

Priyanka Jeyaraj<sup>✉</sup>, Vanitha Jayaraj<sup>✉</sup> and Prathap Suganthirababu<sup>✉</sup>

Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India

### Correspondence:

Vanitha Jayaraj, PhD  
Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, 602105 India.  
E-mail: [vanithajayaraj29@gmail.com](mailto:vanithajayaraj29@gmail.com)

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### ABSTRACT

Parinaud syndrome, or dorsal midbrain syndrome, is a rare neuro-ophthalmological disorder characterized by vertical gaze palsy, convergence-retraction nystagmus, light-near dissociation, and impaired convergence. Rehabilitation literature has primarily focused on motor outcomes in stroke, with limited evidence on visual rehabilitation in this Syndrome. A 39-year-old female presented with acute thalamic-midbrain hemorrhage and developed Parinaud Syndrome with vertical gaze palsy, convergence-retraction nystagmus, diplopia, and impaired near point of convergence. A structured visual-vestibular rehabilitation protocol was implemented, consisting of orthoptic training (pencil push-ups, stereogram fusion, saccadic tracking, smooth pursuits) and vestibulo-ocular reflex (VOR) training (gaze stabilization drills). The program was delivered for 4 weeks, 5 sessions per week. The patient showed partial restoration of upward gaze, improved convergence, reduced diplopia, and enhanced gaze stability. Near point of convergence improved, facilitating better reading ability and daily visual tasks with less fatigue. Functionally, she reported greater independence and confidence in activities requiring visual control. This case demonstrates the effectiveness of targeted visual-vestibular rehabilitation in Parinaud Syndrome, highlighting the role of orthoptic and vestibulo-ocular reflex exercises in improving ocular motility and functional vision. Future studies exploring digital eye-tracking and virtual reality may further enhance rehabilitation outcomes in this rare condition.

**KEYWORDS** midbrain syndrome, orthoptic exercises, stroke, health and wellbeing, quality of life

## INTRODUCTION

Parinaud syndrome, also known as dorsal midbrain Syndrome, is a rare neuro-ophthalmologic disorder that results from lesions affecting the dorsal aspect of the midbrain, particularly structures involved in controlling vertical eye movement. Clinically, it is characterized by vertical gaze palsy, light-near dissociation of the pupils, and convergence-retraction nystagmus, with occasional signs like eyelid retraction and ptosis also reported

(1, 2). Common etiologies include pineal gland tumors, stroke, multiple sclerosis, and traumatic injuries involving the rostral midbrain (3).

Rehabilitation in such patients must therefore address both motor and visual components to achieve functional independence. Effective visual-vestibular rehabilitation promotes good health and well-being by reducing visual disability and improving functional independence. Emerging techniques in visual and vestibular rehabilitation,

such as orthoptic exercises and vestibulo-ocular reflex (VOR) training, have shown promising results in improving visual tracking, eye alignment, and gaze stability, especially in conditions involving the brainstem and cerebellum (4-6). The VOR functions to stabilize visual images on the retina during rapid head movements by generating equal and opposite eye movements. This reflex arc involves the semicircular canals, vestibular nuclei, and ocular motor nuclei, maintaining gaze stability and postural control (7).

Orthoptic training targets ocular coordination and convergence, while VOR exercises improve gaze control during head movements, both of which are essential for enhancing spatial orientation and postural stability (8). Integrating these approaches in stroke rehabilitation may not only support neuroplastic recovery of visual pathways but also improve engagement in activities of daily living (ADLs) (9).

Previous studies have shown that VOR -based rehabilitation improves gaze stability and balance (4, 8), while others report variable outcomes depending on lesion site and training intensity (5). This case report aims to describe the effectiveness of an integrated visual-vestibular rehabilitation program combining orthoptic and VOR training in a patient with Parinaud Syndrome following thalamic-midbrain hemorrhage.

## CASE REPORT

A 39-year-old female with no known comorbidities presented with complaints of right-sided upper and lower limb weakness, slurred speech, and deviation of the angle of the mouth, symptoms which began around 11:30 PM, as reported by her husband. On initial examination, the patient appeared drowsy. She was diagnosed with an acute haemorrhagic stroke and was admitted to the intensive care unit for one week for acute medical management until she became medically stable.

Following stabilization, the patient was transferred to the neurology ward for further evaluation and interdisciplinary rehabilitation. A computed tomography (CT) scan revealed an acute intraparenchymal haemorrhage with active bleeding and mass effect involving the left thalamus, Thalamo-capsular region, and extending inferiorly to the left cerebral peduncle and superiorly to the left corona radiata. Perifocal edema was present. The

clinical and radiological findings were consistent with Parinaud's syndrome. CT and magnetic resonance imaging (MRI) scans were repeated every four weeks over a two-month period to monitor progression.

The patient reported blurred vision and difficulty in focusing on near objects since the onset of stroke, with gradual worsening over two weeks. She had no prior visual disorders or comorbidities and was not on any neuroactive medication. Psychologically, she expressed frustration and fear of dependency due to visual disorientation and imbalance.

Neurologically, the patient exhibited impaired upward gaze, resulting in vertical gaze palsy. This limitation significantly impacted her ability to engage in ADLs independently, due to restricted visual tracking.

The multidisciplinary rehabilitation plan focused on patient and caregiver education, outlining the rehabilitation goals, expected outcomes, and duration of inpatient stay. The core goals were to improve ADL independence such as eating, grooming, bathing, dressing, and toileting as well as to promote functional mobility and community reintegration. Emphasis was placed on safety during ambulation and return to independent living.

To address visual deficits related to Parinaud's syndrome, a specialized visual-vestibular rehabilitation protocol was implemented. This included orthoptic exercises to improve convergence and ocular alignment, and VOR training to enhance gaze stability. Light-near dissociation: pupils constrict normally to a near object but have a delayed or abnormal response to light, assessed under both dim and bright conditions. Near point of convergence: it helps assess the overall efficiency of the eye's vergence system, which is crucial for tasks requiring near vision, Diplopia-Double vision when seeing near objects. Written informed consent was obtained from the patient for participation and publication of this report.

## METHODS

This case report describes the rehabilitation of a 39-year-old female diagnosed with Parinaud Syndrome secondary to a left thalamic-midbrain haemorrhagic stroke. The patient presented with vertical gaze palsy, right hemiparesis, impaired proprioception, and loss of balance. After initial

medical stabilization in the ICU, she was referred for interdisciplinary inpatient neurorehabilitation. Figure 1 shows the ocular motility examination demonstrating impaired upward gaze in Parinaud Syndrome

### Clinical findings

- Vertical gaze palsy (upward gaze restriction)
- Convergence-retraction nystagmus
- Light-near dissociation of pupils
- Diplopia (double vision)
- Near point of convergence deficit.

A comprehensive visual-vestibular rehabilitation protocol was developed, incorporating:

#### Orthoptic exercises

- Targeted interventions included convergence training, pencil push-ups, saccadic tracking, and smooth pursuit tasks. Sessions were delivered for 30 minutes per day, 5 days a week, focusing on improving upward gaze and binocular coordination.

#### Rehabilitation

Protocol for stereogram exercise:

1) Initial positioning: The patient positioned a pen in the middle of the images on the stereogram card while holding it at arm's length.

2) Focus on the pen: The patient was told to keep an eye on the pictures on the card without really looking at them, while gently bringing the pen closer to their nose.

3) Image fusion: The images on the card started to double as the pen got closer (for example, two kittens showing up as four). When the two core pictures reach an ideal point of convergence, they combine into a single image.

4) Refusing to look straight at the card: The patient was instructed to stabilise the fused image while keeping their attention on the pen.

5) Progress: The patient worked to make the central image sharper after it was obtained. The pen was gradually taken out while staying focused on the convergence point.

6) Advanced step: To create a third image without the pen, the patient visualised a point halfway between the card and their eyes as a way to practise voluntary convergence.

Pen convergence exercise protocol:

1) Holding a pen: The patient held a pen at arm's length, focusing on its tip.



**Figure 1.** Ocular motility examination demonstrating impaired upward gaze in Parinaud syndrome

2) Bringing the pen closer: The pen was slowly moved toward the nose while maintaining focus, stopping when double vision occurred.

3) Sustaining convergence: The patient attempted to keep the image single for as long as possible before taking a short break and repeating the exercise.

4) Increasing difficulty: Over time, the patient aimed to bring the pen closer before experiencing diplopia, progressively improving convergence ability (6).

#### VOR training

- Exercises such as gaze stabilization with head movement (VOR x 1 and VOR x 2 drills), using fixed visual targets while performing horizontal and vertical head movements. Initiated in sitting and later progressed to standing and dynamic postures to integrate balance and eye movement control.

- Duration: 20–25 minutes per session, 5 sessions/week for 4 weeks.

The total rehabilitation duration was 4 weeks, with periodic team reviews and goal setting to adapt treatment based on progress.

### Outcomes were assessed pre-and post-intervention using

- Near point of convergence (NPC) -measured using RAF rule (cm).
- Diplopia Rating - self-reported using a 0-10 Visual Analog Scale (VAS).
- Dizziness handicap inventory (DHI) - measures functional, physical, and emotional impact of dizziness.

Baseline and post-intervention results are presented in Table 2

### RESULTS

The patient showed partial restoration of upward gaze and improved convergence ability, reducing episodes of diplopia, as summarized in Table 1. Gaze stability improved with VOR training, enabling clearer vision during head movements and enhancing spatial orientation. Near point of

convergence improved, allowing better focus for reading and daily tasks with less visual strain. Table 2 presents quantitative outcomes. Overall, the patient reported greater functional independence and confidence in performing vision-related ADLs. Table 3 summarizes rehabilitation protocol. The patient reported improved reading ability, better environmental navigation, and reduced visual fatigue during daily tasks.

### DISCUSSION

Parinaud syndrome presents unique rehabilitation challenges due to the combined visual and motor impairments stemming from midbrain pathology. To strengthen understanding of the observed recovery pattern, the following discussion integrates comparative literature, proposed mechanisms, and clinical implications. In this case, the patient exhibited vertical gaze palsy;

**Table 1.** Pre-intervention and post-intervention outcome scores

| Outcome measure                         | Pre-intervention                                          | Post-intervention                                      |
|-----------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|
| Vertical gaze (upward movement)         | Severely restricted, unable to elevate eyes               | Partial restoration, able to sustain brief upward gaze |
| Convergence (near point of convergence) | Poor convergence, early diplopia at ~20 cm distance       | Improved NPC, diplopia only after prolonged near work  |
| Diplopia (double vision)                | Frequent during near and distance tasks, affecting ADLs   | Markedly reduced, occasional only with fatigue         |
| Light-near dissociation                 | Pupils sluggish response to light, accommodation impaired | Near accommodation improved, clearer near focus        |

ADLs, activities of daily living; NPC, near point of convergence

**Table 2.** Quantitative changes in visual-vestibular function following 4 weeks of orthoptic and vestibulo-ocular reflex training

| Outcome measure   | Assessment tool            | Pre-intervention | Post-intervention | % improvement |
|-------------------|----------------------------|------------------|-------------------|---------------|
| NPC               | RAF rule (cm)              | 20 cm            | 8 cm              | 60.0%         |
| Diplopia severity | Visual Analog Scale (0-10) | 8                | 3                 | 62.5%         |
| DHI               | Questionnaire              | 64               | 28                | 56.0%         |

NPC, near point of convergence; RAF, Royal Air Force rule; DHI, Dizziness Handicap Inventory

**Table 3.** Summary of rehabilitation protocol

| Phase    | Exercise type                                   | Frequency   | Duration | Progression criteria                     |
|----------|-------------------------------------------------|-------------|----------|------------------------------------------|
| Week 1-2 | Orthoptic: pencil push-ups, stereogram fusion   | 5 days/week | 30 min   | Maintain single vision for 5 sec         |
| Week 2-3 | VOR x1 (horizontal/vertical gaze stabilization) | 5 days/week | 20 min   | Stable gaze without dizziness            |
| Week 3-4 | Combined orthoptic + VOR x 2 tasks              | 5 days/week | 45 min   | Functional improvement and ADL tolerance |

VOR, vestibulo-ocular reflex; ADL, activities of daily living

therefore a targeted visual-vestibular rehabilitation strategy was essential (10).

**Comparison with Literature:** Similar improvements have been reported in earlier research. Sheikh et al. demonstrated that VOR training enhances gaze stability and balance control following brain injury (4). Porciatti et al. emphasized the role of orthoptic therapy in improving convergence and binocular coordination in neuro-ophthalmologic disorders (5). Conversely, Herdman and Clendaniel noted that retention of VOR adaptation varies depending on lesion location and exercise intensity. These findings suggest that individualized progression and repetition are essential for sustained improvement (8).

**Recent studies have illustrated that orthoptic exercises are widely used in patients with neuro-ophthalmologic deficits to improve convergence, accommodation, and saccadic function.** Elambirainathan et al. and Jones et al. reported that orthoptic exercises improve visual function. Their inclusion in this case contributed to partial restoration of upward gaze and improved functional visual behavior during ADL performance (6, 11). Additionally, a study discovered that orthoptic exercises help manage convergence and fusion impairments, highlighting the necessity of a planned rehabilitation approach (9).

**Mechanisms of Improvement:** The patient's progress may be explained by neuroplastic reorganization within the brainstem and cerebellar circuits. Repetitive oculomotor and vestibular stimuli likely enhanced sensory recalibration, strengthening eye-head coordination and gaze stabilization. The integration of orthoptic and VOR tasks promoted both cortical and subcortical adaptations, facilitating smoother visual tracking and reduced diplopia during functional tasks.

### Limitations and clinical relevance

Being a single-case report, the findings cannot be generalized to all Parinaud Syndrome patients. The absence of long-term follow-up and lack of advanced eye-tracking assessments are notable limitations. However, this case provides valuable clinical insights for physiotherapists on incorporating visual-vestibular exercises into rehabilitation programs for brainstem stroke. The approach highlights the importance of early, task-specific oculomotor retraining in improving

daily functional vision.

Future investigations should include larger cohorts and objective tracking tools, such as infrared oculography or virtual reality-based gaze assessment, to further validate these outcomes.

## CONCLUSIONS

The integrated orthoptic and VOR -based visual-vestibular rehabilitation resulted in measurable improvement in convergence (55.0%), reduced diplopia (62.5%), and better gaze stability, enabling functional visual recovery in Parinaud Syndrome. These results highlight the clinical relevance of physiotherapeutic visual training in neuro-ophthalmologic conditions.

**Ethical Approval:** The case protocol was reviewed and approved by the Institutional Review Board of Saveetha Institute of Medical and Technical Sciences.

**Patient Consent:** Written informed consent was obtained from the patient for participation and publication

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## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

## AUTHOR CONTRIBUTIONS

P.J.: conceptualization, methodology, investigation, data curation, writing – original draft; V.J.: supervision, validation, writing – review & editing, project administration; P.S.: formal analysis, resources, visualization, writing – review & editing.

The authors have no conflicts of interest to report.

## DATA AVAILABILITY STATEMENT:

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

## INSTITUTIONAL REVIEW BOARD STATEMENT

The case protocol was reviewed and approved by the Institutional Review Board of Saveetha Institute of Medical and Technical Sciences.

## INFORMED CONSENT STATEMENT

Written informed consent was obtained from the patient for participation and publication.

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