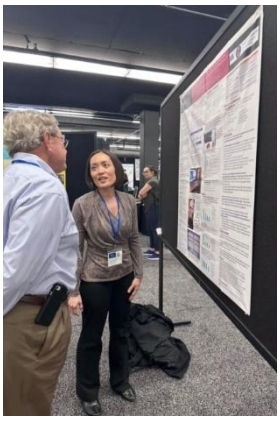
# Latest Neurogen™ Research

## Neurogen™ Case Report for the Treatment of Light Sensitivity after Mild Traumatic Brain Injury


Dr. Jenalyn Jotie, a U.S. Navy Veteran and fellowship-trained neuro-optometrist, recently published a case report in the journal of Vision Development and Rehabilitation investigating the use of Neurogen™ for the treatment of light sensitivity after mild traumatic brain injury in one Post-9/11 Veteran. She presented her findings at the annual Neuro-Optometric Rehabilitation Association 2023 conference in Portland, OR. https://pubs.covd.org/VDR/issue9-3/



After sustaining multiple TBIs throughout his military career and in his lifetime, the 48-year-old Veteran reported disabling light sensitivity for several years, often keeping the blinds closed at home and sometimes having to wear sunglasses indoors. After 8 active treatment sessions and 4 placebo/sham sessions of Neurogen™ over 6 weeks, the Veteran reported significant improvements in his light sensitivity (59% reduction), general post-concussive and headache symptoms (73% and 37% reduction respectively) via the following validated questionnaires: the Utah Photophobia Symptom Impact Scale (UPSIS-17), Rivermead Post-Concussion Symptoms Questionnaire (RPCSQ), and the Headache Impact Test (HIT-6). (See Appendices

### I. Study Findings

#### A. Utah Photophobia Symptom Impact Scale (UPSIS-17)

The Veteran initially reported moderate/severe PS symptoms (UPSIS-17=49) that reduced by 59% (UPSIS-17=20) after 12 LIP-tES sessions (Figure 1). The greatest relative reduction occurred at Visit #5 (-36% change from the initial) and tapered off between the end of the treatment arm and the end of

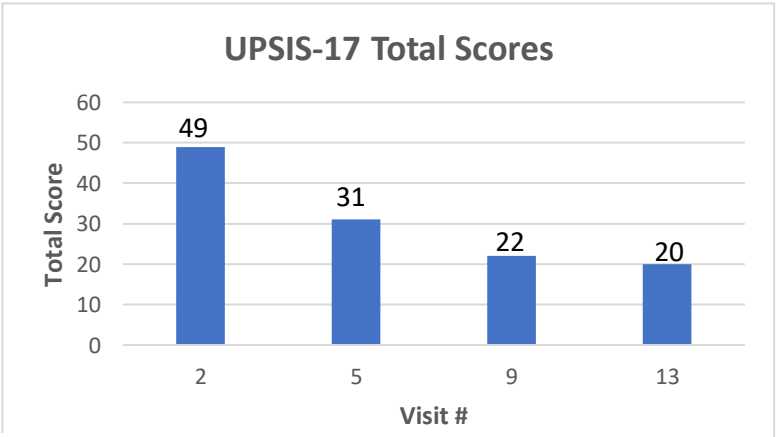



***Figure 1.*** *Change in UPSIS-17 Total Scores from Pre-Treatment (Visit #2), Mid-Treatment (Visit #5), End of Treatment arm (Visit #9) and End of Sham/Placebo Arm (Visit #13).*

the sham/placebo arm (-9% between visits #9 and #13).

**B. Rivermead Post-Concussion Symptoms Questionnaire (RPCSQ)**

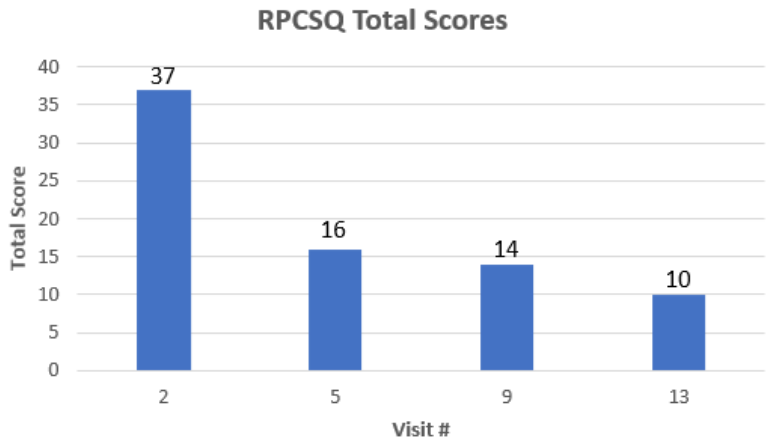



***Figure 2:*** *Change in RPCSQ Total Scores from Pre-Treatment (Visit #2), Mid-Treatment (Visit #5), End of Treatment arm (Visit #9) and End of Sham/Placebo Arm (Visit #13).*

The severity of post-concussive symptoms reduced by 73% from the 85th percentile of males between 41-64 years old with at least one chronic health condition[1] (RPCSQ=37) to below the 50th percentile (RPCSQ=10) at the end of 12 LIP-tES sessions (Figure 2). The sharpest reduction in symptoms occurred at Visit #5 and was stable from middle of the treatment arm to the end of the Sham/Placebo arm (Visits #5-13). RPCSQ Item #14 refers to the symptom of "light sensitivity, easily upset by bright light." The Veteran had a 67% reduction in PS symptoms from a "moderate problem" (RPCSQ Item #4=3) to "no more of a problem" (RPCSQ Item #4=1) at the end of the study. He had the greatest symptom reduction for RPCSQ Item #7, "Being irritable, easily angered," from 4 ("severe problem") to 1 ("no more of a problem") at the end of 12 LIP-tES sessions.

**C. Headache Impact Test (HIT-6)**

The Veteran experienced a 37% reduction in headache symptoms from severe headaches (HIT-6=63) before LIP-tES treatment to minimal or no impact (HIT-6=40) at the end of 12 LIP-tES sessions (Figure 3). HIT-6 scores of >60 are classified as "severe"; "substantial" for scores between 56-59; having "some impact" for scores between 50-55 and scores of <49 are considered to have little or no impact on ADLs[2,3]

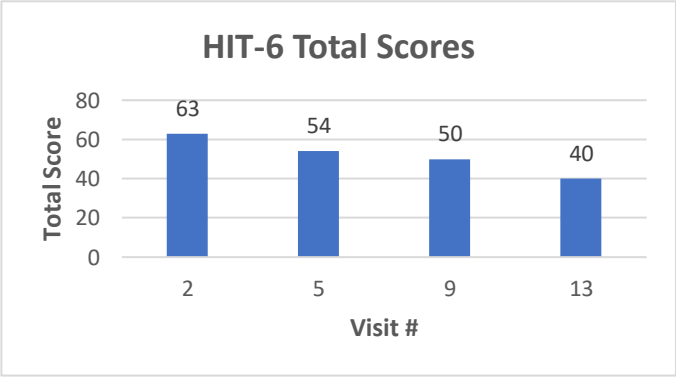



***Figure 3:*** *Change in HIT-6 Total Scores from Pre-Treatment (Visit #2), Mid-Treatment (Visit #5), End of Treatment arm (Visit #9) and End of Sham/Placebo Arm (Visit #13).*

**II. Subjective Improvements**

Outside the structured questionnaires (see Appendices A-C), the Veteran reported major subjective improvements in his daily life, including doing yardwork one day and realizing that he had forgotten to wear his sunglasses outdoors. After a history of anger management issues, he observed at the end of the Neurogen™ study that "little things no longer bothered me."

Data from this case report was included as supporting evidence for the Small Projects in Rehabilitation Research (SPiRE) grant proposal to fund a larger 2-year pilot study investigating Neurogen to treat photosensitivity after mild traumatic brain injury at the VA Boston.

# Small Projects in Rehabilitation Research Grant awarded to fund Neurogen™ Pilot Study at VA Boston

The Small Projects in Rehabilitation Research Grant (SPiRE) is a federal grant funded through the VA Office of Research and Development to support translational research pilot studies with the aim of improving the rehabilitation outcomes of Veterans. The $230,000 grant was awarded to the Harvard-affiliated Cognitive and Sensory Systems Laboratory (CASSL) https://projects.iq.harvard.edu/fortenbaugh to fund a 2-year pilot study at the VA Boston to investigate the use of Neurogen™ to treat light sensitivity after mild traumatic brain injury. The pilot study is now open for recruitment on ClinicalTrials.gov https://clinicaltrials.gov/study/NCT06109909?term=photosensitivity&aggFilters=status:not&rank=1

The goal of the SPiRE pilot study is to test the feasibility and acceptability of low-intensity pulse-based transcranial stimulation (LIP-tES) neurofeedback intervention, using the NeurogenTM technology, for reducing photosensitivity symptoms in Veterans with a history of mild traumatic brain injury (mTBI). The study will also complete resting-state MRI scans to assess neurophysiological markers of photosensitivity and changes associated with the LIP-tES intervention. The study is estimated to be completed by November 2025.

# Appendix A : UPSIS-17 Questionnaire[4]

1) Overall, how severe do you consider your light sensitivity?
*(Where 0 equals no light sensitivity, and 5 equals the worst light sensitivity possible.)*
0 1 2 3 4 5

2) How unpleasant is strong light during the headache free period?
*(Where 0 equals not unpleasant, and 5 equals very unpleasant.)*
0 1 2 3 4 5

3) How unpleasant is strong light during a headache?
0 1 2 3 4 5

4) How much stronger is your sensitivity to light during the attack than when headache free? *(Where 0 equals the same, and 5 equals much stronger.)*
0 1 2 3 4 5

5) How often does strong light provoke a headache?
*(Where zero equals never, and 5 equals very often.)*
0 1 2 3 4 5

Please answer questions 6-14 on a 0-5 scale concerning your light sensitivity *during the headache free period*, with 0 being no limitation, 3 being moderate limitation due to light sensitivity, and 5 being marked limitation because of light sensitivity.

6) How difficult do you find it to function under fluorescent lights?
0 1 2 3 4 5

7) How difficult is it for you to look at a computer screen for any period of time?
0 1 2 3 4 5

8) How much does light sensitivity affect your ability to read?
0 1 2 3 4 5

9) How much does light sensitivity affect your ability to watch television?
0 1 2 3 4 5

10) How much does light sensitivity affect your ability to watch movies in a theatre?
0 1 2 3 4 5

11) How much does light sensitivity affect your ability to go shopping (i.e. grocery and department stores)?
0 1 2 3 4 5

12) How much does light sensitivity affect your ability to do housework or to work outside the home?
0 1 2 3 4 5

13) How much does light sensitivity affect your ability to walk about?
0 1 2 3 4 5

14) How much does light sensitivity affect your ability to drive?
0 1 2 3 4 5

15) How much does light sensitivity affect your ability to ride in a car?
0 1 2 3 4 5

16) A) Do you wear sunglasses to decrease headaches?
YES NO

B) If **YES (to #16A)**, where?
Outdoors Indoors Both

17) A) Do you currently drive?
YES NO

B) If **NO (to #17A)**, is it because of light sensitivity?
YES NO

C) If **YES (to #17A)**, does light sensitivity affect your ability to drive?
YES NO

D) If **YES (to #17A)**, what effect does it have?
_____Cannot drive at night because of light sensitivity
_____Can drive in daytime, but need to wear sunglasses
_____Can drive only short distances because of light sensitivity

## Appendix B : Rivermead Post-Concussion Symptoms Questionnaire (RPCSQ)[5]

After a head injury or accident some people experience symptoms which can cause worry or nuisance. We would like to know if you now suffer any of the symptoms given below. As many of these symptoms occur normally, we would like you to compare yourself now with before the accident. For each one please circle the number closest to your answer.

0 = Not experienced at all
1 = no more of a problem
2 = a mild problem
3 = a moderate problem
4 = a severe problem

Compared with before the accident,
do you now (i.e. over the last 24 hours) suffer from:

| | | | | | |
|---|---|---|---|---|---|
| Headaches | 0 | 1 | 2 | 3 | 4 |
| Feelings of dizziness | 0 | 1 | 2 | 3 | 4 |
| Nausea and/or vomiting | 0 | 1 | 2 | 3 | 4 |
| Noise sensitivity, easily upset by loud noise | 0 | 1 | 2 | 3 | 4 |
| Sleep disturbance | 0 | 1 | 2 | 3 | 4 |
| Fatigue, tiring more easily | 0 | 1 | 2 | 3 | 4 |
| Being irritable, easily angered | 0 | 1 | 2 | 3 | 4 |
| Feeling depressed or tearful | 0 | 1 | 2 | 3 | 4 |
| Feeling frustrated or impatient | 0 | 1 | 2 | 3 | 4 |
| Forgetfulness, poor memory | 0 | 1 | 2 | 3 | 4 |
| Poor concentration | 0 | 1 | 2 | 3 | 4 |
| Taking longer to think | 0 | 1 | 2 | 3 | 4 |
| Blurred vision | 0 | 1 | 2 | 3 | 4 |
| Light sensitivity, easily upset by bright light | 0 | 1 | 2 | 3 | 4 |
| Double vision | 0 | 1 | 2 | 3 | 4 |
| Restlessness | 0 | 1 | 2 | 3 | 4 |

Are you experiencing any other difficulties?
Please specify, and rate as above:

| | | | | | |
|---|---|---|---|---|---|
| 1._____ | 0 | 1 | 2 | 3 | 4 |
| 2._____ | 0 | 1 | 2 | 3 | 4 |

## Appendix C: Headache Impact Test Questionnaire (HIT-6)[6]

**Headache Impact Test Questionnaire (HIT-6)**

1) When you have headaches, how often is the pain severe?

Never Rarely Sometimes Very Often Always

2) How often do headaches limit your ability to do usually daily activities including household work, work, school, or social activities?

Never Rarely Sometimes Very Often Always

3) When you have a headache, how often do you wish you could lie down?

Never Rarely Sometimes Very Often Always

4) In the past 4 weeks, how often have you felt too tired to do work or daily activities because of your headaches?

Never Rarely Sometimes Very Often Always

5) In the past 4 weeks, how often have you felt fed up or irritated because of your headaches?

Never Rarely Sometimes Very Often Always

6) In the past 4 weeks, how often did headaches limit your ability to concentrate on work or daily activities?

Never Rarely Sometimes Very Often Always

**References**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