Convergence Insufficiency Treatment using Virtual Reality

Vision and Learning Center

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BACKGROUND

The incidence of convergence insufficiency (CI) in the US population can be as high as 8%. CI is a condition in which the individual has decreased facility of convergence, decreased fusional vergence range, and reduced near point of convergence (NPC). Symptoms include diplopia, asthenopia, blurred vision, fatigue, and head tilt/lean (Scheiman, 2005). CI is thought to manifest early in life and children with CI may show behavioral symptoms that are typical of attention-deficit/hyperactivity disorder (ADHD), as symptomatic children avoid school work due to consequences of their poor binocular vision (Rouse, et al., 2009). Vision therapy has demonstrated effectiveness in treating CI (Scheiman, 2005).

CASE SUMMARY

A 35-year-old white female presented with complaints of diplopia. The patient's history included a concussion at age 10 and was prescribed ADHD medication due to difficulty performing school work as a sequelae from the trauma. The patient was diagnosed with CI in 2014 at a medical facility and was prescribed 5Δ base-in single vision glasses. In 2015, she was prescribed 16Δ base-in bifocals due to worsening symptoms.

In 2017, the patient visited a vision therapy (VT) clinic due to debilitating diplopia and asthenopia that prevented her from studying graduate coursework. She was prescribed in-office vision therapy but was unable to continue the office visits. The patient started home-based therapy using Vivid Vision Home (VVH) along with other activities. (Fig 1) The VVH modules included activities for anti-suppression, vergence, and stereopsis.

TREATMENT DEVICE

Figure 1 - Vivid Vision Home utilizes a virtual reality headset. The clinician monitors patient progress and adjusts the treatment plan remotely.

TREATMENT TASK AND STIMULI

Figure 2 – Step Vergence works on fusional vergence ranges by increasing prismatic demands at distance and/or near.

RESULTS

Examination Data

Date	CT Distance	CT Near	NPC	RDS
2015 - December	10 XP	30 XP	N/A	N/A
2016 - April	10 XP	30 XP	N/A	N/A
2017 - September	Ortho	14 XP	12”/36”	140"
2018 - January	Ortho	14 XP	12”/24”	None
2018 - June	4 XP	10 XP	12”/24”	100"
2018 - July	Ortho	14 XP	4”/12”	30"
2018 - October	Ortho	Ortho	TTN	30"
2019 - January	Ortho	Ortho	TTN	70"

Figure 3 – Patient examination history

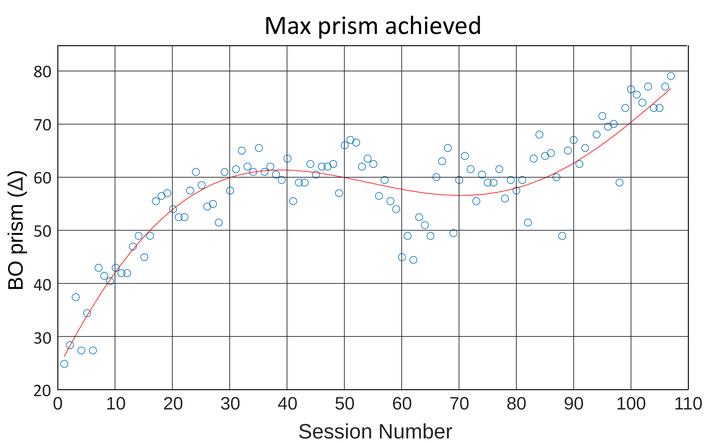

Figure 4 – Patient gameplay history in the VVH Vergence activity

DISCUSSION

The Convergence Insufficiency Treatment Trial (CITT) recommended in-office vision therapy as a treatment option for convergence insufficiency (Scheiman, 2005). The study compared various treatments, such as home-based and in-office treatment. Regarding home treatment, the group doing pencil push-ups out-performed a group that used a non-VR home computer-based vergence/accommodative treatment (Scheiman, 2005).

Our patient's success with home-based therapy could be due to one or more factors. Virtual Reality (VR) is a new method that has only recently become practical for visual rehabilitation. Using a head mounted display along with tele-medicine software, the clinician has the ability to control the patient's visual environment during treatment. This allows binocular vision disorders to be treated daily (Žiak, et al., 2017).

VR activities are engaging and they can be made more representative of real-world scenes than traditional anaglyphs. The visual inputs can be manipulated without using additional filters. Vergence, disparity, and other binocular functions can be adjusted by an algorithm or directly by the clinician. This treatment presumably contributed to improvements in the patient's vergence range, stereopsis, and phoric posture. (Fig 3, Fig 4) The patient also recorded a decrease in symptoms, notably a cessation of double vision and asthenopia, and a dramatic recovery of the ability to study.

Even though the patient's vergence range and phoric posture are now within normal limits, additional VT is indicated to treat a residual accommodative insufficiency. This is difficult to do in VR, as the focal distance of VR headsets is typically fixed.

REFERENCES

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